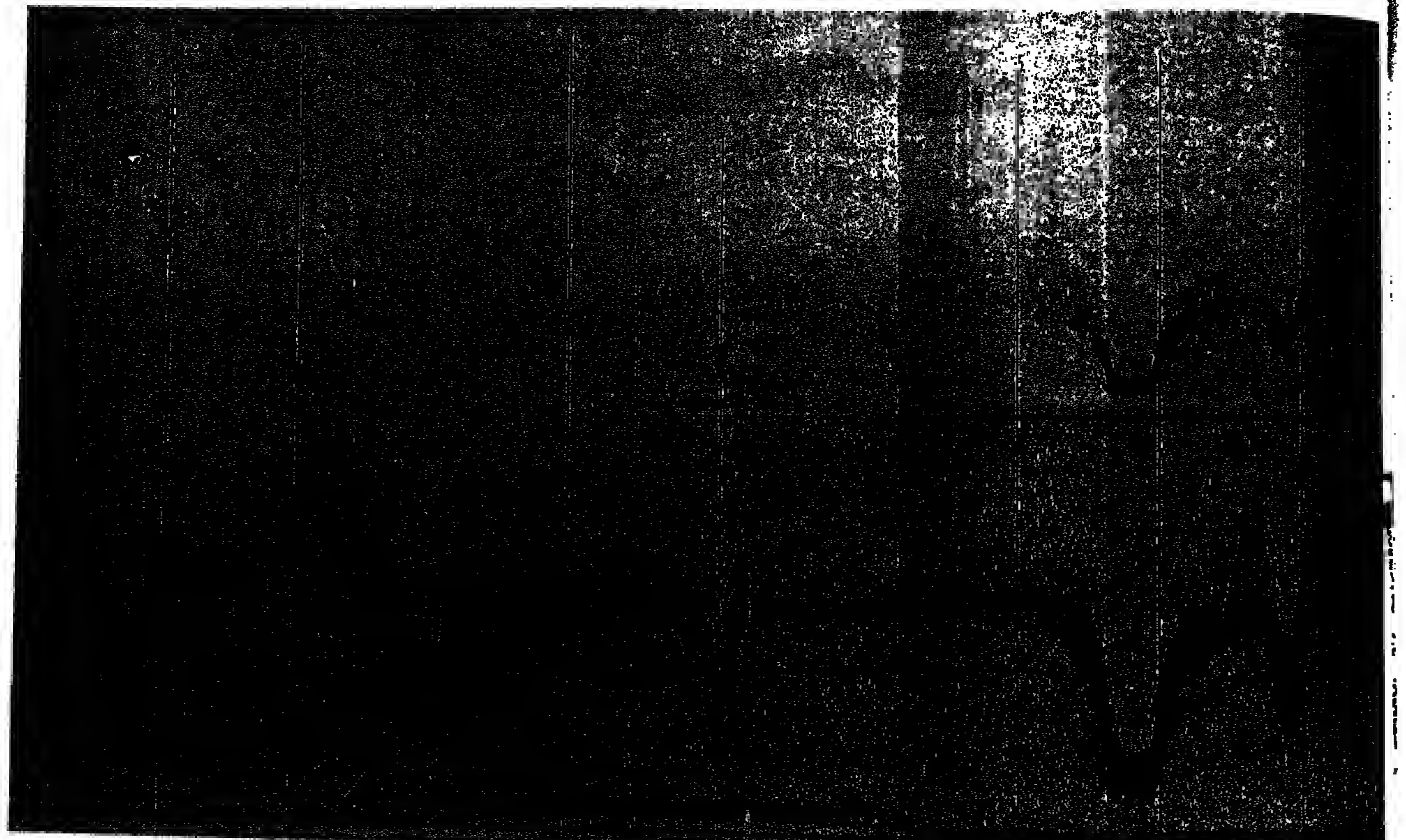


EOS
Transactions, American Geophysical Union
Vol. 65 No. 6 February 7, 1984

Eos, Transactions, American Geophysical Union Vol. 65, No. 6, Pages 41–48 February 7, 1984

MOVING?
Give AGU your new address!
Please allow up to 6 weeks for change to be effected if mailed. Only one notice needed for AGU membership record and all AGU subscriptions. Return this panel, with label, to:
American Geophysical Union
2000 Florida Avenue, N.W.
Washington, DC 20009
For faster action,
Call toll free 800-424-2488,
or call (202) 462-6903.
Wire Western Union Telex 710-822-9300.
Please print or type new address
New phone numbers (will be published in Membership Directory)
Office ( )
Home ( )

Particles and Fields—Ionosphere

5510 Ion densities and temperatures
A THEORETICAL F-REGION STUDY OF ION COMPOSITIONAL AND TEMPERATURE VARIATIONS IN RESPONSE TO MAGNETOSPHERIC STORM INPUTS
J. J. Sojka (Center for Atmospheric and Space Sciences, Utah State University, Logan, Utah 84322), and R. W. Schunk

The response of the polar ionosphere to magnetospheric storm inputs was modeled. During the 'storm', the spatial extent of the auroral oval, the intensity of the precipitating auroral electron energy flux, and the plasma convection pattern were varied with time. The convection pattern changed from a symmetric two-cell pattern with a 64 kV cross-tail potential to an asymmetric two-cell pattern with enhanced plasma flow in the dusk sector and a total cross-tail potential of 90 kV. During the storm there were significant changes in the ion temperature, ion composition, and molecular/atomic ion transition heights. The storm-time asymmetric convection pattern produced an ion temperature hot spot at the location of the dusk convection cell owing to increased ion-neutral frictional heating. In this hot spot there were significantly enhanced NO+ densities, and hence, molecular/atomic ion transition heights. During the storm recovery phase, the decay of the enhanced NO+ density closely followed the decrease in the plasma convection speed. During the storm, elevated ion temperatures also appeared at high altitudes in the midnight-dawn auroral oval region. These elevated ion temperatures were a consequence of the storm-enhanced topside O+ densities, which provided better thermal coupling to the hot electrons. This region also contained reduced molecular/atomic ion transition heights. These elevated ion temperatures and reduced transition heights persisted for several hours after the storm main phase ended.
J. Geophys. Res., A, Paper 4A0055

5540 Ion densities and temperatures
SATURN'S IONOSPHERE: INFERRED ELECTRON DENSITIES
M. L. Kaiser, M. D. Desch, J. E. P. Connerney (Laboratory for Extraterrestrial Physics, NASA Goddard Space Flight Center, Greenbelt, MD 20771)

During the two Voyager encounters with Saturn, radio bursts were detected which appear to have originated from atmospheric lightning storms. Although these bursts generally extended over frequencies from as low as 100 kHz to the upper detection limit of the instrument, 40 MHz, they often exhibited a sharp but variable low frequency cutoff below which bursts were not detected. We interpret the variable low-frequency extent of these bursts to be due to the cutoff and reflection of the radio waves as they propagate through an ionosphere which varies with local time. We obtain estimates of electron densities at a variety of latitude and local time locations. These compare well with the dawn and dusk densities measured by the Pioneer 11 and Voyager Radio Science investigations, and with model predictions for daytime densities. However, we infer a two-order-of-magnitude diurnal variation of electron density, which had not been anticipated by theoretical models of Saturn's ionosphere, and an equally dramatic attenuation of ionospheric electron density by Saturn's rings. (Saturn, electron density, ionosphere).
J. Geophys. Res., A, Paper 4A0051

5560 Particle precipitation
AVERAGE ELECTRON PRECIPITATION PATTERNS AND VISUAL AURORAL CHARACTERISTICS DURING GEOMAGNETIC QUIESCENCE

5560 Particles and Fields—Ionosphere (Particle Precipitation)
VELOCITY SHEAR STABILIZATION OF THE CURRENT CONVECTIVE INSTABILITY

5583 Plasma motion, convection, or circulation
THE EFFECTS OF INTERPLANETARY MAGNETIC FIELD ORIENTATION ON DAYSIDE HIGH LATITUDE IONOSPHERIC CONVECTION

5570 Plasma instabilities
THE WAVE NORMALS OF MAGNETOSPHERIC CHORUS EMISSIONS OBSERVED ON BOARD GEOS 2

5550 Wave propagation
PROPAGATION OF PLASMA WAVE ENERGY IN THE AURORAL F-REGION

News

Geophysics and Overall Science Strong in FY 1985 Budget

A Mars mission, a new research thrust on the continental lithosphere, increased efforts in digital cartography, and construction of a Very Long Baseline Array radio telescope top the list of highlights for geophysics-related research in the proposed fiscal 1985 federal budget that President Ronald Reagan sent to Congress earlier this month.

Science in general fared well in this fourth Reagan budget. Research and development support would grow 14% to $53 billion ($51.8 billion would go to conduct of R&D, while $1.3 billion would be allocated to R&D facilities). With a projected inflation rate of about 4%, this increase would provide real growth of 10% over fiscal 1984 levels. The largest increase for R&D, 22%, would support defense modernization. Figure 1 compares nondefense federal R&D obligations since 1978 in constant 1983 dollars, while Table 1 compares conduct of R&D by major departments and agencies.

Basic research would get the next largest hike, up 10% to $7.9 billion, or about 6% growth above projected inflation. Agencies primarily supporting basic research in physical sciences and engineering are slated for better than a 14% boost, while those primarily supporting life and other sciences would get a 5.2% increase. Figure 2 compares basic research obligations in constant 1983 dollars for the five agencies with the largest basic R&D budgets.

Of the four nondefense agencies most involved in geophysical research, the National Science Foundation fared best with a 12.4% hike; the National Aeronautics and Space Administration is slated for almost a 4% increase. The U.S. Geological Survey took a slight dip (down 3.8%) in the budget request, but the National Oceanic and Atmospheric Administration's support would shrink 9.5%.

Congress, with an eye on the calendar and the November elections, has already begun work on the budget (see the list of budget hearings in this issue). *Eos* will track the budget as it moves through Congress.

Note: Increases and decreases listed in the following analysis compare the differences between fiscal 1984 and fiscal 1985, and do not reflect manual changes in the funding profile when a program phases in, matures and peaks, and then phases out. Numbers may not total because of rounding.

NSF Budget Up 12.4%

The budget request for the National Science Foundation is $1,501.79 million:

- $1,308.2 million for research and related activities
- $115.08 million for the U.S. Antarctic Program
- $75.7 million for science and engineering education
- $2.8 million for special foreign currency

Proposed are funds for

- construction of the Very Long Baseline Array (VLBA) radio telescope
- an expansion of efforts begun in fiscal 1984 to address researchers' needs for advanced computer systems
- initiation of centers for cross-disciplinary research in engineering

In addition, the budget request nearly doubles the money allocated for the Presidential Young Investigator Research Awards, which were initiated in fiscal 1984. In fiscal 1985, NSF plans to continue support for the 200 scientists selected this year and to support an additional 200. About half of the awards will be made to engineering faculty.

The following percentage increases and dollar requests are slated for the budgets of the various directorates that involve research and related activities:

- Engineering, 21.8% to $147.1 million
- Mathematical and Physical Sciences, 16.1% to $416.7 million
- Biological, Behavioral, and Social Sciences, 12.7% to $255.1 million
- Scientific, Technological, and International Affairs, 14.3% to $46.9 million
- Astronomical, Atmospheric, Earth, and Ocean Sciences (AAEO), 13.2% to $371.5 million.

Within AAEO, the following percentage increases and dollar amounts are proposed.

- Astronomical Sciences, 19.5% to $93.4 million
- Earth Sciences, 17.1% to $48.6 million
- Ocean Sciences, 9.9% to $124.9 million
- Atmospheric Sciences, 10.3% to 98.6 million
- Arctic Research Program, 82% to $8.0 million.

Astronomical and Atmospheric Sciences

Slightly more than one-third of the $93.4 million proposed for the **astronomical sciences** division of AAEO is slated to support the National Radio Astronomy Observatory ($33.4 million, up 62.1%). Construction of the VLBA radio telescope will be the centerpiece of this program, as recommended by the National Research Council's Astronomy Survey Committee. Support for the Kitt Peak National Observatory, the Cerro Tololo Inter-American Observatory, and the National Solar Observatory totals $24.8 million (up 4.9%). The two other components of the astronomical sciences division are slated for smaller increases: astronomy project support is slated for $28.9 million (an increase of 4.3%), while the National Astronomy and Ionosphere Center would get $6.3 million (up 1.6%).

For astronomy project support, the biggest increases are proposed for extragalactic astronomy (up 28.5% to $7.5 million) and for galactic astronomy (up 17.6% to $5.3 million). Increases also proposed for fiscal 1985 are for solar system astronomy (up 1.8% to $1.3 million) and for stars and stellar evolution (up 3% to $6.5 million). Funds to support research on the electromagnetic spectrum management would remain the same as in fiscal 1984 ($100,000), while astronomical instrumentation and development would take a 15.2% cut to $8.2 million.

In the **atmospheric sciences** division, the largest increase is slated for the National Center for Atmospheric Research (NCAR) (up 14.8% to $45.9 million). Most of this increase results from the proposal for the installation of an advanced vector computer at the Boulder-based center. (Scientific computing would get a 42.2% boost to $13.4 million.) Other increases within NCAR would go to atmospheric analysis and prediction (up 4.5% to $3.6 million), to atmospheric chemistry and aeronomy (up 4.5% to $2.9 million), to convective storms (up 1% to $2.4 million), and to advanced study programs (up 4.5% to $1.5 million). Support for administration and support services is slated to increase 4.5% to $4.9 million and contractor fees are expected to rise 4.0% to $941,000. Physical plant operation and maintenance would get $3.3 million, a 42.3% hike. Slated for slight decreases at NCAR are funds for the High Altitude Observatory (down 2.1% to $3.5 million) and atmospheric technology (down 2.3% to $7.5 million).

Atmospheric sciences project support, the largest component of the atmospheric sciences division, would get $48.5 million, an increase of 6.0%. Proposed increases for individual projects hover around 8%: aeronomy is budgeted for $6.6 million, atmospheric chemistry for $7.3 million, climate dynamics for $7.8 million, experimental meteorology for $5.6 million, meteorology for $9.1 million, and solar terrestrial research for $7.7 million. The Global Atmospheric Research Program (GARP) continues to phase down (a decrease of 6.4% to $4.5 million) with data analysis well underway.

The Upper Atmospheric Research Facilities program, the smallest component of the division, would get a 7.9% increase to $4.1 million.

Earth and Ocean Sciences

Most of the proposed increase for the **earth sciences** division goes to the continental lithosphere program. Recommended as a chief emphasis by the National Research Council's Board on Earth Sciences in their report, *Opportunities for Research in the Geological Sciences* and by the National Academy of Science's Research Briefing Panel on the Solid Earth Sciences (*Eos*, December 20, 1983, p. 985), this program would get $7.7 million in fiscal 1985, up from $3.7 million in fiscal 1984.

After the continental lithosphere program, the largest increase goes to instrumentation and facilities (up 20% to $6 million).

All of the other programs within the division are also slated for increased funding in fiscal 1985: stratigraphy and paleontology, up 5.4% to $3.9 million; surficial processes, up 7.4% to $2.9 million; crustal structure and tectonics, up 5.3% to $4.0 million; petrogenesis and mineral resources, up 5.1% to $4.1 million; volcanology and mantle geochemistry, up 8.3% to $3.9 million; and experimental and theoretical geochemistry, up 7% to $6.1 million. The seismology program and the experimental and theoretical geophysics program each would rise 6.4% to $5.0 million.

In the **ocean sciences** division, funding for the Ocean Drilling Program is slated to increase 4.9% to $27.6 million. Although costs for the program are expected to rise from $29.5 million in fiscal 1984 to $37.6 million in fiscal 1985, the contribution from other nations is expected to jump from $1.2 million to $10 million. Drilling is expected to commence at the start of fiscal 1985 (*Eos*, January 31, 1984, p. 33). Ocean science research support, the second component of the ocean sciences division, would get an 11.5% hike to $60.9 million. This support funds research in physical oceanography ($17.2 million, up 11%), marine chemistry ($13.4 million, up 11.7%), submarine geology and geophysics ($16.1 million, up 11%), and biological oceanography ($14.2 million, up 12.7%). The third component of ocean sciences, called oceanographic facilities and support, is slated for an 11.1% increase to $30.4 million.

Polar Programs

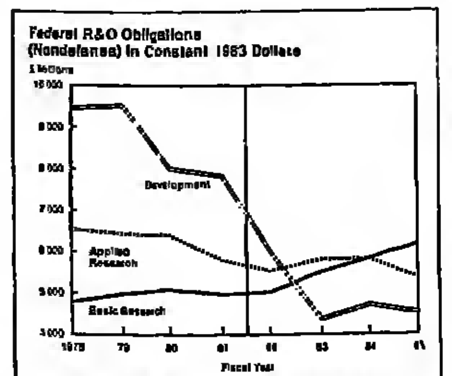
AAEO's **arctic research** division would receive $8.0 million for fiscal 1985, an increase of more than 8% over the current fiscal year. Biological sciences research is slated for the largest dollar increase, up $229,000 to $2.2 million, followed closely by atmospheric sciences (up $120,000 to $1.1 million) and earth sciences (also up $120,000 to $1.2 million). Glaciology research has been slated for a 7.1% increase to $2.1 million, while the funding for oceanography research in the Arctic remains unchanged at $1.2 million.

Money requested for the **U.S. Antarctic Program**, which is a separate activity and not part of AAEO, totals $115.1 million, an increase of $12.6 million over fiscal 1984. Antarctic research (up 7.4% to $11.0 million) includes funding for atmospheric sciences ($2.2 million, up 18%), biological sciences ($2.5 million, down 3.9%), earth sciences ($1.8 million, up 5.9%), glaciology ($1.9 million, up 18.8%), oceanography ($1.9 million, up 19.2%), and information and advisory services ($700,000, up 7.7%). Operations support for the U.S. Antarctic Program will increase 12.9% to $104.1 million.

Engineering

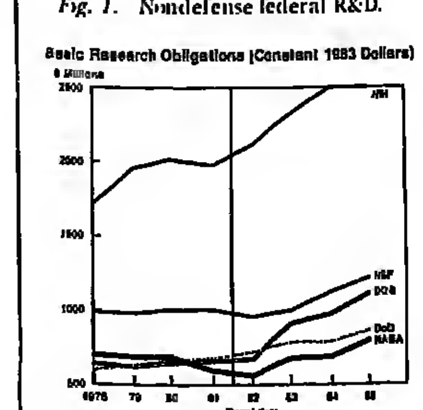
Within the Directorate for Engineering, the Division of Civil and Environmental Engineering is slated to receive $39.8 million, a 17.7% boost. Within the division, requested is $4.0 million (up 17.9%) for geotechnical engineering, $4.7 million (up 34.3%) for structural mechanics, $4.3 million (up 23.0%) for hydraulics, hydrology, and water resources en-

News (cont. on p. 50)



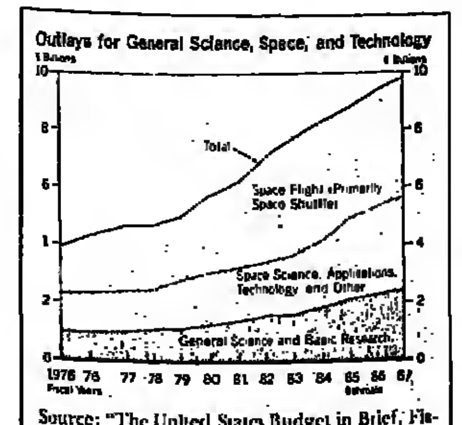
Source: Office of Science and Technology Policy.

Fig. 1. Nondefense federal R&D.



Source: Office of Science and Technology Policy.

Fig. 2. Basic research in five federal agencies.



Source: "The United States Budget in Brief, Fiscal 1985," Office of Management and Budget.

TABLE 1. Research and Development by Major Departments and Agencies in Millions of Dollars

Department or agency	Obligations 1983 Actual	Obligations 1984 Estimate	Obligations 1985 Estimate	Outlays 1983 Actual	Outlays 1984 Estimate	Outlays 1985 Estimate
Defense-military functions	22,925	27,636	33,852	21,057	25,310	31,053
Energy	4,491	4,814	4,885	4,771	4,853	4,744
Health and Human Services	4,348	4,859	4,950	4,092	4,529	4,809
National Institutes of Health*	(3,788)	(4,240)	(4,342)	(3,598)	(3,968)	(4,267)
National Aeronautics and Space Administration	2,570	3,257	3,311	2,538	3,402	3,314
National Science Foundation	1,002	1,239	1,408	992	1,136	1,362
Agriculture	846	872	898	832	866	880
Transportation	360	519	498	280	445	481
Interior	374	415	303	403	403	368
Commerce	327	357	272	324	349	276
Environmental Protection Agency	241	250	281	312	252	277
Agency for International Development	177	225	264	235	298	297
Veterans Administration	164	223	198	154	174	208
Nuclear Regulatory Commission	207	191	168	220	211	167
All other**	338	393	390	340	390	416
Total	38,431	45,279	51,776	36,560	42,686	48,712

Source: Office of Management and Budget. Numbers may not total because of rounding.
*Figures in parentheses are part of the corresponding amount for Health and Human Services.
**Includes the departments of Education, Justice, Labor, Housing and Urban Development, and Treasury, the Tennessee Valley Authority, the Smithsonian Institution, the U.S. Army Corps of Engineers, and the Federal Emergency Management Agency.

Forum

Two-Career Couples: Information Exchange

AGU's Education and Human Resources Committee sponsored a panel session on The Dual-Career Couple at the 1983 AGU Fall Meeting (a report on the session will appear in a forthcoming issue of *Eos*). The response was overwhelming—more than 150 persons crowded into the room, many of them mid-career professionals. Clearly, we had touched a nerve. In discussion following the panel presentation, members of the audience repeatedly expressed a desire for models, guidelines, or policy statements that could be shown to an employer, especially with reference to flexible work time, slow career advancement, and promotion policy. People felt that alternatives are feasible, and that the present lack of policies is largely due to ignorance, by both employers and employees, of practical solutions. "Surely, with so many women entering the work force, some corporations or agencies must have developed guidelines!"

It would be inappropriate for AGU to propose any such guidelines. However, we can collect and publicize information that might be useful. Below is a short list of relevant publications, kindly provided by Jennie Farley of the School of Industrial and Labor Relations at Cornell. **Members who know of other publications or policy statements by employers are urged to share this information via the AGU Committee on Education and Human Resources.**

The Woman in Management: Career and Family Issues, Jennie Farley, ILR Press, Cornell University, Ithaca, N. Y., 112 pp., 1983, $8.95.

Career Outcomes in a Matched Sample of Men and Women Ph.D.'s: An Analytical Report, N. C. Ahern and E. L. Scott, National Academy Press, Washington, D. C., 1981.

Careers and Couples: An Academic Question, L. Hoffmann and G. DeSole (Eds.), Modern Language Association, New York, 1976.

Corporations and Two-Career Families: Directions for the Future, Catalyst Career and Family Center, New York, 1981.

Climbing the Academic Ladder: Doctoral Women Scientists in Academe, NRC Commission on Human Resources, National Academy of Sciences, Washington, D. C., 1979.

Constance Sancetta
Member, AGU Education and Human Resources Committee

News (cont. from p. 49)

generating, $3.8 million (up 15.2%) for environmental and water quality engineering, $2.4 million (up 20.2%) for construction engineering and building research, and almost $20 million (up 13.1%) for earthquake hazard mitigation.

NASA: Mars and Space Station

Although the proposed fiscal 1985 budget for the National Aeronautics and Space Administration (NASA), totaling $7491.1 million, shows just under a 4% increase over fiscal 1984, the budget includes three major new initiatives. Most loudly touted of these is a permanently manned space station, for which $150 million is requested (see story this issue).

Another initiative, a Mars mission called the Mars Geoscience/Climatology Orbiter (MGCO), would be "the first of a new series of relatively low-cost planetary observers designed to investigate specific questions in planetary science," according to NASA Administrator James M. Beggs. MGCO was part of the core program for planetary exploration recommended by the Solar System Exploration Committee of the NASA Advisory Council (Eos, May 24, 1983, p. 386, and February 15, 1983, p. 65). The funds requested in the fiscal 1985 budget ($16 million—within the planetary exploration category) would begin the design and development of the orbiter and its instruments, leading to a 1990 launch. MGCO will measure the geology and climatic evolution of Mars.

Development of the Upper Atmosphere Research Satellite (UARS) will begin in fiscal 1985. UARS will place into earth orbit an instrument that will enable a comprehensive, global measurement of the stratosphere to be made.

Space Flight

Largest of the four NASA budget categories is Space Flight, Control, and Data Communications, which, with proposed funding totaling $[illegible] million, represents almost half of the agency's budget. This category includes space shuttle production, operations, and tracking and data acquisition. Next largest is research and development ($[illegible] million), followed by research and program management ($[illegible] million) and construction of facilities ($[illegible] million).

Space Flight, Control and Data Communications is a new category representing an internal reorganization at the agency. Plans for fiscal 1985 include 11 space shuttle launches, the second and third spacelab missions, launch of the second and third Tracking and Data Relay Satellites (TDRSS), completion of the space shuttle fleet with the expected delivery of the fourth orbiter (Atlantis) in December 1984, and continued hardware development for the [illegible] Satellite System. Specifically, funding for space shuttle production and operational capability drops [illegible]% to $[illegible] million, while space transportation operations [illegible] to $[illegible] million. Support for space tracking and data acquisition grows [illegible]% to $[illegible] million. Despite the extensive plans, total funding for this category shows a [illegible]% decrease from fiscal 1984, reflecting a maturation of the shuttle program.

Research and Development

Six activities fall under NASA's research and development category. (1) The largest is space science and applications, allocated with $[illegible] million, an increase of [illegible]%. (2) The new space station would get $150 million in fiscal 1985, while (3) space transportation capability development is budgeted for $[illegible] million, shrinking [illegible]%. (4) Technology utilization would be funded at $[illegible] million, (5) aeronautics and space technology, $[illegible] million, up $[illegible] million, and (6) tracking and data acquisition, $[illegible] million, up to $[illegible] million.

Physics and Astronomy

The space science and applications activity, in turn, is divided into four programs. The first, physics and astronomy, is budgeted for $[illegible] million, an increase of [illegible]% over fiscal 1984. The largest increases within this program would go to mission operations and data analysis (up [illegible]% to $[illegible] million), to Gamma Ray Observatory development (up [illegible]% to $[illegible] million), and to shuttle/spacelab payload development and mission management (up [illegible]% to $[illegible] million). Smaller increases are allocated to the suborbital program (up [illegible]% to $[illegible] million), to Explorer development (up [illegible]% to $[illegible] million), and to research and analysis (up [illegible]% to $[illegible] million). Largest for a slight decrease: space telescope development (down [illegible] to $[illegible] million).

Planetary Exploration

Planetary exploration, the second program within space science and applications, is budgeted for a [illegible]% increase to $[illegible] million. Most of the increase is attributable to the addition of $[illegible] million [illegible] to support the Venus Radar Mapper mission, bringing the total for fiscal 1985 to $92.5 million. The newly proposed Mars Geoscience/Climatology Orbiter is budgeted for $16.0 million. Hefty increases also are slated for the International Solar Polar Mission (up 80% to $9 million) and to mission operations and data analysis (up 35.5% to $58.8 million). Because much of the foundation work is completed for the development of Galileo, a decrease of 29.4% to $56.1 million is proposed. Research and analysis is slated for an 8.1% cut to $34.5 million.

Space Applications

Space applications, the third component of the space science and applications subactivity, would get an overall 18.2% boost to $344.1 million. This program is divided into solid earth observations (down 15.6% to $63.6 million), environmental observations (up 36.2% to $220.7 million), materials processing in space (down 2.5% to $23.0 million), communications (down 2.4% to $20.0 million), and information systems (up 82% to $10.2 million).

Within solid earth observations, funding for the shuttle/spacelab payloads would grow 13.1% to $18.1 million, while geodynamics and research and analysis would each increase 6.8% to $29.9 million and $15.6 million, respectively. There is no money in the NASA budget for Landsat-D (which, as the in-orbit Landsat-D, is handled by the National Oceanic and Atmospheric Administration).

Within environmental observations, support for the upper atmosphere research satellite mission would more than triple to $60.7 million. Extended mission operations is budgeted for $29.3 million (up 7.7%), upper atmosphere research and analysis would get $31.0 million (up 8.8%), atmospheric dynamics and radiation research and analysis would get $28.5 million (up 3.0%), oceanic processes research and analysis would get $18.4 million (up 6.0%), and space physics research and analysis would receive $16.7 million (unchanged from fiscal 1984). Funding for the shuttle/spacelab payload development would grow 2.6% to $7.8 million. Additions to the program include the scatterometer ($15 million), the tethered satellite payloads ($3.0 million), and microbiology research and analysis ($1 million). Funding for the earth radiation budget experiment (ERBE) nearly halves to $8.1 million. The operational satellite improvement program is eliminated in the fiscal 1985 budget request.

The life sciences program, the fourth component of the space science and applications activity, is budgeted for a 9.1% increase to $63.[illegible] million.

USGS Underscores Mapping

Funding for the U.S. Geological Survey (USGS) proposed for fiscal 1985 totals $391.8 million (a decrease of 3.8% from fiscal 1984) (see Table 2 for a breakdown of major categories). Digital cartography, part of the national mapping program, has been allocated a $3.3 million increase. The additional funds will initiate digitizing of hydrography and transportation data for the country at a scale of 1:100,000. This will aid the Bureau of Census prepare for the 1990 census.

Geologic and Mineral Resources

Within the geologic hazards subactivity within Geologic and Mineral Resources, none of the programs are budgeted increases. The earthquake hazards reduction program would receive $33.1 million (down 6.2%), resulting in a 10% reduction in earthquake monitoring networks and approximately a 15% reduction in quake prediction networks. Ten projects in earthquake prediction studies and five field projects on earthquake potential in California would be discontinued. The volcanic hazards program would get $9.5 million (down 12.8%), and the ground failure and construction hazards program would get $2.1 million (same as fiscal 1984).

The land resource surveys subactivity, with a total proposed budget of $20.0 million for fiscal 1985, includes the geomagnetism program (down 9.1% to $2 million), the climate changes program (halved to $0.5 million), and the geologic framework program (up 24.1% to $17.5 million). These cuts would mean delaying final magnetic chart production for about 1 year, eliminating two research projects to develop new mathematical models, and terminating investigations assessing the link between climate change and variations in the earth's magnetic field. The geologic framework program incorporates the reactor hazards program that had previously been included in the geologic hazards subactivity and includes a $1 million initiative for cooperative federal/state geologic and geophysical mapping.

The mineral resource surveys subactivity shows a $1.4 million increase to $46.3 million. Slated for the largest percentage increase is development of assessment techniques, up 4.1% to $12.8 million. Also allocated funding growth are the Alaska program (up 1.1% to $9.5 million), the coterminous states program (up 3.5% to $5.9 million), the wilderness program (up 2.4% to $8.5 million), and the strategic and critical minerals program (up 3.3% to $9.5 million). Increases for the coterminous states and the critical minerals programs were for pay cost increases.

Energy geologic surveys would show a net decline of 13.0% to $26.0 million. Some of the money from the coal investigations program and the onshore oil and gas investigations program has been moved into a new program called "evolution of sedimentary basins," which has been budgeted for $4.7 million in the fiscal 1985 budget request. Coal investigations would get $7.4 million and onshore oil and gas investigations would receive $4.7 million. Oil shale investigations would grow 20% to $600,000. Decreases are proposed for uranium/thorium investigations (down 19.5% to $3.3 million) and for the geothermal program (down 25% to $5.4 million), suspending studies of shallower, high-temperature hydrothermal resources. The world energy program has been eliminated.

The fifth subactivity, offshore geologic surveys, would get a 2.7% increase to $19.1 million. A significant part of the work would focus on assessing the mineral and energy resources in the 200-mile Exclusive Economic Zone.

Water Resources

Within the National Water Data System: Federal Program subactivity, a $900,000 increase has been allocated to the data collection and analysis program, bringing its budget up to $16.9 million in the next fiscal year. Other increases within the subactivity have been apportioned to the improved instrumentation program (up 5% to $2.1 million), the water resources assessment program (up 7.7% to $1.4 million), the toxic substances program (formerly called the toxic waste-groundwater contamination program) (up 4.7% to $8.9 million), the acid rain program (up 6.7% to $3.2 million), the environmental affairs program (up 14.3% to $800,000), and the coordination of national water data activities program (up 11.1% to $1.0 million to cover pay cost increases).

Decreases in the subactivity are slated for the national water data exchange program (down 23.1% to $1.0 million) (resulting in a 10% reduction in capability to respond to inquiries), the regional aquifer systems analysis program (down 3.3% to $14.6 million), the core program of hydrology research (an 8.5% drop to $6.5 million), and supporting services (a two-thirds cut to $1.1 million). The budget this year keeps the water resources scientific information center at $300,000 and again allocates no money to the flood hazard analysis program.

Within the National Water Data System: Federal/State Cooperative Program, the data collection and analysis program would get a 1.7% boost to $42.7 million to cover pay cost increases, while funding for the water use program would drop by nearly 25% to $3.0 million. The coal hydrology program has been allocated $4.4 million, a 37.5% increase.

In the energy hydrology subactivity, the nuclear energy hydrology program would receive $7.6 million (up 5.6%) and the oil shale hydrology program would receive the same funding as in fiscal 1984, $300,000. The coal hydrology program that had been contained in this subactivity has been consolidated with the coal hydrology program in the federal/state cooperative program.

The Water Resources Research Institute has been eliminated from the Water Resources Investigations activity.

TABLE 2. USGS Budget, in Millions of Dollars

Activity	FY 1983	FY 1984	FY 1985 Proposal	Change, 1984 to 1985, in Percent
Geologic and Mineral Resource Surveys				
Geologic hazards	51.6	51.4	44.8	−12.8
Land resource surveys	17.5	17.2	20.0	+16.3
Mineral resource surveys	41.1	44.9	46.3	+3.1
Energy geologic surveys	31.2	30.1	26.0	−13.6
Offshore geologic surveys	15.5	18.6	19.1	+2.7
Subtotal	159.8	162.2	156.2	−3.7
Water Resources Investigations				
National water data system: federal program	55.1	60.3	58.5	−3.0
National water data system: federal/state cooperative program	45.8	49.1	50.1	+2.0
Energy hydrology	15.1	11.9	7.9	−33.6
Water Resources Research Institute	0	6.4	0	−100.0
Subtotal	116.0	127.5	116.6	−8.7
National Mapping Program	90.7	90.1	90.4*	+0.3
Facilities	9.0	10.4	13.3	+27.9
General administration	14.9	16.5	15.4	−0.6
Total, USGS	390.5	405.9	391.8	−3.5

Source: USGS. Numbers may not total because of rounding.
*Includes $11.3 million for digital cartography, up 41.3% from FY 1984 and up 182% from FY 1983.

NOAA Budget Declines

The total budget appropriation request for the National Oceanic and Atmospheric Administration (NOAA) is $899.3 million, a decrease of $94.2 million from the fiscal 1984 appropriation of $993.5 million. The budget includes proposals for users of NOAA's services to pick up a greater share of the costs, for the continued funding of the Next Generation Weather Radar (NEXRAD) and the modernization of the National Weather Service, and for the procurement and operation of two geostationary and one polar-orbiting meteorological satellites. The budget request consists of a programs requirement of $1,017.8 million, which would be offset by various transfers, adjustments, and revenues from service charges that total $118.5 million.

The lion's share of NOAA's funding would go to Operations, Research, and Facilities (ORF), targeted to receive $921.5 million, $93.3 million less than appropriated for fiscal 1984. Many of the cuts proposed for ORF had been requested for fiscal 1984, but were subsequently restored by Congress. ORF is divided into five activities: ocean and coastal programs, marine fishery resource programs, atmospheric programs, satellite and environmental data and information services, and program support.

Atmospheres and Satellites

Atmospheric Programs

Better than one-third of ORF's funds would go to the atmospheric programs activity. The budget request of $358.2 million (down 2.1% from fiscal 1984) is split between public warning and forecasting services ($311.0 million, virtually unchanged from FY 1984) and atmospheric and hydrologic research ($47.2 million, down $6.1 million). Among the proposals included in the decreases for public warning and forecasting services are closing the southern region headquarters, eliminating regional hydrologists offices, reducing staff at eight weather service forecast offices, and reducing night staffs at those offices. The decreases slated for atmospheric and hydrologic research include reducing funding to the Prototype Regional Observations and Forecast Service (PROFS) (Eos, April 13, 1982, p. 293), to National Weather Service research and development, to acid rain research, and the elimination of research and some services at the Solar Environmental Laboratory.

Satellites and Environmental Data and Information Services

The second largest of ORF's five activities, Satellite and Environmental Data and Information Services, is budgeted for $271.7 million in fiscal 1985, an increase of $22.3 million. The largest boost—25%—within this activity would go to the satellite services subactivity. The $84.9 million allocated would allow NOAA to assume responsibility for the Gilmore Creek, Alaska, data acquisition station now operated by NASA, and would fund operation processing of solar backscatter ultraviolet data and for correction of system deficiencies in the polar ground system. In addition, the geostationary satellite's temperature and moisture sounding capability would be converted from a research prototype to an operation system by upgrading the ground system.

Satellite systems, the largest subactivity, is slated for a 4.1% hike to $164.2 million, which would allow the procurement of a spacecraft and associated launch services to continue to convert to a one polar satellite system. Funding for the last subactivity, data and information services, would show a 14% drop to $22.6 million.

Ocean and Coastal Programs

Next largest of ORF's activities, called ocean and coastal programs, allocated $108.1 million (a drop of better than 25%), is itself divided into six categories: nonliving marine resources (cut by nearly two-thirds to $1.3 million), ocean research (cut by one-third to $18.0 million), ocean services (down 29.6% to $19.1 million), Sea Grant (once again proposed for elimination), mapping, charting, and geodesy programs (slated to increase by 25% to $62.2 million), and coastal zone management, which in the past Congress has budgeted separately (slated to receive $5.6 million).

Within nonliving marine resources, the budget request proposes to eliminate the polymetallic sulfide program and the ocean thermal energy conversion program. Cuts to the ocean research subactivity include terminating the Undersea Research Program and shrinking the OASIS/LOGA project. Also proposed is the closing of the Great Lakes Environmental Research Laboratory (GLERL); the fiscal 1984 budget request also proposed to close the laboratory (Eos, May 17, 1983, p. 378), but Congress restored it.

Increases for the ocean services subactivity are proposed to offset the cost of producing tide and current publications; receipts from charges for this service will be deposited in the federal treasury. Decreases are proposed for, among others, the circulatory program, the marine boundary survey program, the Chesapeake Bay study, and the bathymetric swath survey system project. The fiscal 1985 budget proposes to terminate the Sea Grant Program; Congress has restored the program every year.

Although the program level will remain the same for the mapping, charting, and geodesy subactivity, decreases are proposed in aeronautical chart services and nautical chart services. Direct funding of technical support to state geodesy programs would be reduced and a state-specific geodetic survey program would be eliminated. The president's budget requests that nautical and aeronautical chart prices be increased to more accurately reflect their full market value.

Coastal zone management (CZM) has been included in ocean and coastal programs with a proposal to phase out the CZM state grants program, to eliminate the states' assistance program, and to reduce the estuarine sanctuary program.

Marine Fishery & Program Support

The marine fishery resource programs, the fourth activity within ORF, is budgeted for a 35.7% cut to $92.6 million. This includes $59.1 million (down $12.7 million) for information collection and analysis, $29.1 million (down $21.1 million) for conservation and management operations, and $4.1 million (down $17.2 million) for state and industry programs.

ORF's last activity, program support, has been allocated $92.8 million, a cut of 17.2% from fiscal 1984. Proposed decreases include eliminating the National Advisory Committee on Oceans and Atmosphere (NACOA), reducing general administration, deactivating the fisheries research fleet, reducing days at sea, laying up of the Surveyor and the Fersel, reducing maintenance on both those ships and on Freeman, and closing the southeast marine support facility.—BTR

Budget Hearings

The tentative schedule for congressional hearings on the Reagan budget request for fiscal 1985 is listed below. Dates and times should be verified with the committee or subcommittee holding the hearing; all offices on Capitol Hill may be reached by telephoning 202-224-3121.

February 22: National Science Foundation (NSF), by the Science, Technology, and Space Subcommittee of the Senate Commerce, Science, and Transportation Committee. Senate Russell Office Building, Room SR-253, 9:30 A.M.

February 22: National Aeronautics and Space Administration (NASA), by the Space Transportation Systems?, by the Space Science and Applications Subcommittee of the House Science and Technology Committee. Rayburn House Office Building, Room 2325, 1 P.M.

February 23: U.S. Geological Survey, by the Interior and Related Agencies Subcommittee of the House Appropriations Committee. Rayburn House Office Building, Room B308, 10 A.M.

February 23: NSF, by the Science, Technology, and Space Subcommittee of the Senate Commerce, Science, and Transportation Committee. Senate Russell Office Building, Room SR-253, 9 A.M.

February 28: NASA, by the Science, Technology, and Space Subcommittee of the Senate Commerce, Science, and Transportation Committee. Senate Russell Office Building, Room SR-253, 9:30 A.M.

February 28: NSF, by the Science Research and Technology Subcommittee of the House Science and Technology Committee. Rayburn House Office Building, Room 2318, 2 P.M.

February 29: NASA (space tracking and data systems and technology utilization), by the Space Science and Applications Subcommittee of the House Science and Technology Subcommittee. Rayburn House Office Building, Room 2325, 1 P.M.

February 29: NSF by the Science Research and Technology Subcommittee of the House Science and Technology Committee. Rayburn House Office Building, Room 2325, 9:30 A.M.

March 1: NASA, by the Science, Technology, and Space Subcommittee of the Senate Commerce, Science, and Transportation Committee. Senate Russell Office Building, Room SR-253, 9 A.M.

March 1: NASA (construction of facilities and research and program management), by the Space Science and Applications Subcommittee of the House Science and Technology Committee. Rayburn House Office Building, Room 2325, 10 A.M.

March 8: NASA, by the Science, Technology, and Space Subcommittee of the Senate Commerce, Science, and Transportation Committee. Senate Russell Office Building, Room SR-253, 9 A.M.

March 15: Markup of the authorization for the NASA budget by the Space Science and Applications Subcommittee of the House Science and Technology Committee. Rayburn House Office Building, Room 2325, 9:30 A.M.

March 29: NASA, by the HUD-Independent Agencies Subcommittee of the Senate Appropriations Committee. Senate Dirksen Building, Room SD-124, 10 A.M.—BTR

Space Station Proposed

In his State of the Union address on January 25, President Ronald Reagan announced that he was directing the National Aeronautics and Space Administration (NASA) to "develop a permanently manned space station, and to do it within a decade."

Included in the NASA budget proposal sent to Congress the following week was $150 million for the station. This is the first request of many; expected costs will total roughly $8 billion by the early 1990's.

As currently configured, the space station will be launched and tended by the space shuttle and provide living and working space for a crew of 6–8 people. Some free-living, unpressurized platforms would carry sensitive instruments that could not function with the natural jostlings of manned modules. NASA, which has been lobbying for a space station for several years, has invited international participation.

Not everyone agrees that a space station would, in the words of President Reagan, "permit quantum leaps in our research in science, communications, and in metals and lifesaving medicines which can be manufactured only in space." A report issued by the National Research Council's Space Science Board asserted that there is no scientific need for such an endeavor for at least 2 decades. In addition, some researchers worry that the program will detract both funds and attention from other programs.

EOS

Transactions, American Geophysical Union

The Weekly Newspaper of Geophysics

For speediest treatment of contributions send three copies of the double-spaced manuscript to one of the editors named below and one copy to AGU.

Editor-in-Chief: A. F. Spilhaus, Jr.; Editors: Marcel Ackerman, Mary P. Anderson, Peter M. Bell (News), Bruce Doe, C. Stewart Gillmor (History), Clyde C. Goad, Arnold L. Gordon, Louis J. Lanzerotti, Robert A. Phinney. Managing Editor: Gregg Forte; News Writer: Barbara T. Richman; News Assistant: Tony Reichhardt; Production Staff: James M. Hebblethwaite, Dae Sung Kim, Patricia Lichiello, Lisa Lichtenstein, Cynthia T. McManigal.

Officers of the Union
James A. Van Allen, President; Charles L. Drake, President-Elect; Leslie H. Meredith, General Secretary; Carl Kisslinger, Foreign Secretary; A. F. Spilhaus, Jr., Executive Director; Waldo E. Smith, Executive Director Emeritus.

For advertising information, contact Robin E. Little, advertising coordinator, toll free at 800-424-2488 or, in the D.C. area, 462-6903.

Copyright 1984 by the American Geophysical Union. Material in this issue may be photocopied by individual scientists for research or classroom use. Permission is also granted to use short quotes and figures and tables for publication in scientific books and journals. For permission for any other uses, contact the AGU Publications Office.

Views expressed in this publication do not necessarily reflect official positions of the American Geophysical Union unless expressly stated.

Subscription price to members is included in annual dues ($20 per year). Information on institutional subscriptions is available on request. Second-class postage paid at Washington, D. C., and at additional mailing offices. Eos, Transactions, American Geophysical Union (ISSN 0096-3941) is published weekly by

American Geophysical Union
2000 Florida Avenue, N.W.
Washington, DC 20009

Cover. Water flow paths in geothermal energy reservoirs are often dominated by fractures, whether natural or hydraulically induced, as is the case in the Los Alamos Hot Dry Rock project. The extracted water must be disposed of after its energy is removed for beneficial purposes, and often the best recourse is to reinject the cooled water back into the same fractures from which it was extracted. In that case the objective is to avoid too early an arrival of the cold recharge at the extraction well and at the same time avoid the expense of piping the recharge great distances away. An attractive alternative in the case of vertical or steeply dipping fractures is to attain adequate separation by using gravity and the density difference between the cold recharge and hot effluent. For a given geometry the effectiveness of gravity separation improves as the ratio of the Grashof and Reynolds numbers increases: Increasing the water density difference or the fracture permeability enhances separation, but increasing the recharge rate diminishes it.

The apparatus in the photos represents a vertical fracture viewed from the side. The upper clear plastic tube provides the hot water outlet; the tube below is used for recharge; and the recirculated water is cooled in a peripheral heat exchanger, not shown. The water is confined between a transparent, Plexiglas sheet (in front) and an electrically-heated back surface. The metal framework attached to the Plexiglas sheet allows accurate and uniform setting of the distance between the confining surfaces, thus controlling the fracture permeability.

Streamlines are observed through the use of two methods. In the first method, using the technique of D. J. Baker (Journal of Fluid Mechanics, 26, 573–575, 1966), fine platinum wires were immersed in the water (which is actually a dilute solution of thymol blue (thymolsulphonephthalein) titrated to the end point). When the wires are electrically charged, the current flow and resulting pH change cause the solution passing over the wires to turn blue. Continued application of voltage on many such wires distributed throughout the fracture reveals the steady state streamline patterns. In the second method, a previously prepared volume of blue solution is injected into the recharge just before entry into the fracture. One then observes the time-development of the fluid motion; this method is analogous to the tracer technique used in actual reservoirs.

In (a) the density difference is zero and the tightly bunched streamline pattern revealed by the charged-wire technique illustrates flow "short circuiting," which results in rapid reduction of effluent temperature. At a moderate Grashof/Reynolds number ratio, 2, the tracer technique reveals the flow pattern in (b), in which a substantial fraction of the recharge first flows downward, thus delaying thermal degradation of the effluent. For a very large Grashof/Reynolds number ratio, 40, the patterns in (c) and (d) result. Using the tracer technique, (c) shows the formation of a descending jet. The charged wires depict, in (d), the water motion after the jet encounters the fracture bottom, turns, and then flows to the extraction tube; thermal degradation is delayed for the maximum possible duration. The oscillatory appearance of the descending jet in (c) is due to the Kelvin-Helmholtz shear instability. Another, more familiar example is the formation of water waves from the wind. (Photos courtesy of investigators Hugh Murphy, Scott Faas (now at Sandia National Laboratories, Livermore, Calif.), and Paul Nabholz (now at SEDCO, Inc., Dallas, Tex.), Los Alamos National Laboratory, Los Alamos, NM 87545.)

Gravity Theory Test Planned

The National Aeronautics and Space Administration (NASA) has decided to proceed with one of the most sophisticated attempts yet to test Einstein's gravitational theory. The proposed Gravity Probe B instrumented spacecraft program has been included in the agency's Fiscal Year 1985 budget request, but only after considerable in-depth evaluation, both scientific and financial. Budgeted at $1.8 million for study in fiscal year 1984, it has been proposed at $3–5 million in fiscal year 1985 under the Physics and Astronomy Research and Analysis section of NASA's budget.

The idea of Gravity Probe B is to test the general theory of relativity by examining in fine detail changes of the precision parameters of an earth orbiting gyroscope (Science, 223, 30, 1984). The gyroscope will be a cryogenically cooled, highly sensitive instrument specifically designed for the measurements. The engineering concepts have been under development for decades, and although the effects being sought are subtle, the experiment is considered to be within the realm of feasibility.

As with almost all experiments designed to test general relativity theory, Gravity Probe B has the appeal of making a substantial contribution to basic physics as well as to astrophysics and geophysics. At the same time, such a contribution carries the stigma of being basic and difficult to obtain and thus a bit far out of the main stream of space science projects.

NASA let the scientific community decide on this project in the sense that a great demonstration of support from a broad sector of scientists could be justification for new funding. Otherwise, Gravity Probe B would have to compete with other planned projects for a place in the existing budget request. "Deputy administrator Hans Mark has simply threatened to delete it from the agency's budget. It is an unusual technique to say the least, but effective: the space science community is obliging him with protests, letters, and outraged statements of support for the mission," according to Science.

This "outrage" resulted in strong endorsement by the Space Science Board and from many powerful supporters within the scientific community. Assuming the the budgets are approved, Gravity Probe B will fly in the early 1990's.—PMB

Active Faulting Near Taupo

The only confirmed fault displacement in New Zealand since that accompanying the 1968 Inangahua Earthquake was observed on June 23 and 24, 1983, 4 km west of Taupo in the Taupo Volcanic Zone, central North Island (Figure 1). Normal displacement occurred on the late Quaternary Kaiapo fault, previously active in 1922, when almost 1 m of normal fault displacement was observed [Grange, 1932]. The Kaiapo fault is one of a number of northeast trending normal faults that constitute the active Taupo Fault Belt [Grindley, 1961]. Current extension rates up to 7 mm per year have been calculated from geodetic observations (Sissons, 1979) across the northern part of the Taupo Volcanic Zone.

Maximum displacement 2 km north of Lake Taupo was 50 mm upthrow to the southeast with 30 mm extension across the steeply dipping normal fault. No strike-slip displacement was observed. Total length of the observed 1983 surface trace is 1200 m, comprising a set of tensional cracks up to 10 m in length, locally left stepping en echelon in nature (Figure 2).

Following several Modified Mercalli (MM) 4–5 intensity earthquakes reported on June 20 and 21, 1983, a local resident noticed a number of cracks near the base of the fault scarp on his property south of Mapara Road. Following more MM 3 and 4 earthquakes on the night of June 23, the cracks propagated to the northeast and on the morning of June 24, a scientific inspection team observed displacement of the surface of Mapara Road.

These earthquakes were part of a local swarm that had commenced on June 16. Earthquake magnitudes were up to 3.9 with a maximum of 20 felt events per day. Earthquake activity in the area of the fault displacement died away by June 29, migrating first to the north then to the south below Lake Taupo. Active fault displacement appears to have ceased following June 23, although seismicity and minor ground deformation continued.

The surface displacement occurred within the Kaiapo tilt-leveling pattern, one of 12 such arrays regularly monitored by New Zealand Geological Survey around Lake Taupo; 47 mm of displacement was measured on one of the 600-m long precise-leveling radials in agreement with the observed surface displacement. In addition, regular measurements of Lake Taupo water level taken as part of a regional vertical deformation monitoring program recorded relative uplift in the epicentral area for at least 3 months prior to the swarm. Rapid subsidence totaling 50 mm and displacement at the Kaiapo Fault were associated with the earthquake swarm (Figure 3).

Prior to the Kaiapo faulting, during an earthquake swarm on the western margin of the Taupo Volcanic Zone in February-March 1983, a seismographic network was established for one week west of Kuiloch (Figure 1). Associated regional uplift (Figure 3) led to additional lake leveling stations being installed.

After the Kaiapo faulting, seismographs were again deployed around the northern shores of Lake Taupo from June 29, 1983, until July 4, 1983, recording events largely to the south of the surface fault displacement, that of magnitude 4.3 on July 1 being the largest event recorded. A composite focal

News (cont. on p. 52)

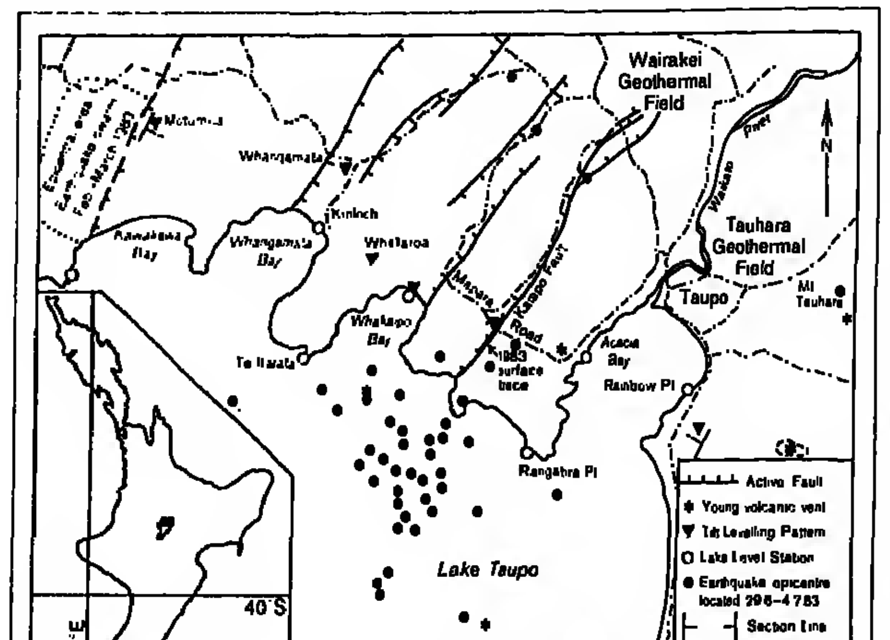
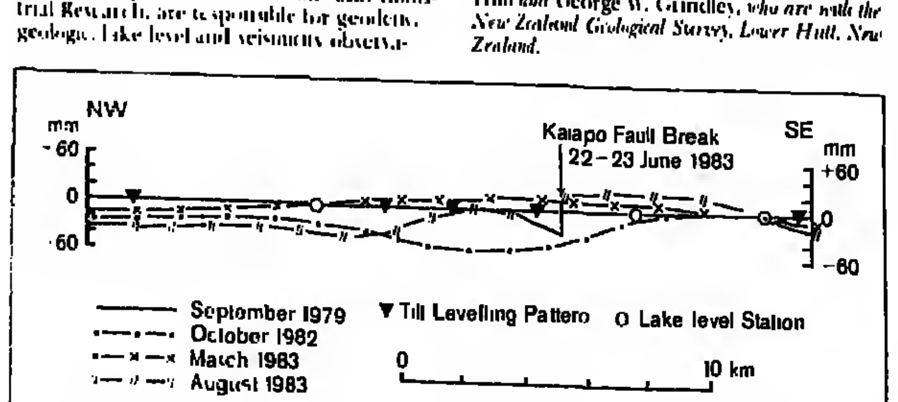


Fig. 1. Northern Lake Taupo region showing epicenters of early July 1983 earthquakes in relation to active faulting and young volcanic centers. Location of Kaiapo Fault break shown.



VLBI Observatory Begins Operations

Geophysicists

Peter S. Engleson

Molecular Computers

A molecular computer is still a long way from being a reality, but interest in their potential is rising rapidly. In a recent workshop on chemical-based computers, sponsored by the National Science Foundation, new avenues for research were being considered. F. Eugene Yates, head of the Crump Medical Institute of the University of California, which cosponsored the conference, stated, "If we go to a molecular computer . . . we're talking about achieving spacing of elements 1/1,000th of that [attainable with silicon] . . . we could probably increase computational diversity between 1 and 10 million times what can be done at present" (*Research and Development*, January 1984).

A competitive molecular computer may not arrive until the next century; however, when it does appear its properties may be impressive. What is predicted is the application of current biological engineering, ranging from those related to recombinant DNA to protein and enzymes. The new biological computers could have "mood" changes to aid in parallel processing of signals. Molecular electronics in general is likely to exploit the full range of biochemical advances. The existing discovery of organic superconductors may find useful application in producing the first resistance-free conduction actually used in computers.—*PMR*

Cornell Continents Institute

Cornell University has formed a new research unit to study the origin and evolution of the continents. Initially, the new Institute for the Study of the Continents will comprise research efforts in geological sciences at Cornell now carried out under the Cornell Program for the Study of the Continents, the Consortium for Continental Reflection Profiling Project, the Andean Project, and related studies of crustal geology. The institute will

Recent Ph.D.'s

Analysis of Solution and Gas Phase Molecular States of Formaldehyde by Gas Chromatography and Chemical Ionization Mass Spectrometry, David F. Utterback, Univ. of North Carolina, Chapel Hill, 1983 (GAX83–26261).

Application of Optimization Methods to the Inversion of Aeromagnetic Data (Brazil), Lourenildo W. B. Leite, Saint Louis Univ., 1983 (GAX83–25388).

Association of Cobalt, Nickel, Copper, and Zinc With Iron and Manganese Oxides of Soils, James A. Frampton, Univ. of California, Davis, 1983 (GAX83–26072).

Clastogenic Activity of Phenolic Oxidation Products, Ann F. Hanham, Univ. of British Columbia (Canada), 1983.

Diagenesis and Reservoir Qualities of the Jurassic Navajo (Nugget) Sandstone in Utah and Southwestern Wyoming, Kadir Uegur, Univ. of Utah, 1983 (GAX83–25942).

Differentiation of the Nebo Granite (Main Bushveld Granite), South Africa, Dennis R. MacCaskie, Univ. of Oregon, 1983 (GAX83–25284).

Effect of Organic Pore Fluids on the Fabric and Geotechnical Behavior of Clays, Eileen D. Gilligan, Syracuse Univ., 1983 (GAX83–25284).

"OH YEAH... I ADDED A FEW KILOPASCALS OF AIR TO ONE OF THE TIRES THIS MORNING."

J. Blanchi

Books

Carbon Dioxide and Climate: A Second Assessment

Report of the CO_2/Climate Review Panel, National Research Council, National Academy Press, Washington, D. C., xx + 72 pp., 1982.

The Long-Term Impacts of Increasing Atmospheric Carbon Dioxide Levels

G. J. MacDonald (Ed.), Ballinger, Cambridge, Mass., xxiv + 252 pp., 1982, $35.

Reviewed by A. Berger

Introduction

There are quite a large number of excellent publications now available in the domain of carbon dioxide and climate. After a period of intense research on the subject conducted under the sponsorship of national and international institutions like the U.S. National Research Council, the U.S. Department of Energy, the Environment Agency of the Federal Republic of Germany, the Scientific Committee on Problems of the Environment, the International Institute for Applied Systems Analysis, the World Climate Program, the Commission of the European Communities and others, syntheses are now possible.

Over the past decades, extreme climatic events in different parts of the world have made us aware of our vulnerability to climatic variations and variability. But it is also more and more recognized that not only man may possibly be affected by climate but also that climate is vulnerable to man's activities. These human activities, especially those related to industrial processes and the practice of agricultural farming and soil management, result in the release of particles and trace gases in the atmosphere. The increase of atmospheric CO_2 which is worldwide poses a special problem of major concern.

2. Principal scientific issues in modelling studies, where the global climate sensitivity is analyzed from simplified models and empirical approaches; the role of the ocean in the transient response of climate and of sea-ice is discussed; the cloud effects are treated through the cloudiness-radiation feedback and the stratus-sea-ice interactions; trace gases other than CO_2 and atmospheric aerosols are recognized as providing another potentially significant and complex source of climate variability; and finally the need for model validation, their current state and their improvement are reviewed.

3. Predictions and scenarios of climate changes due to CO_2 increases, where the global-average, the zonal, and the geographic responses to scenarios of CO_2 increase are investigated not only through a 1-dimension radiative-convective model but also through comprehensive General Circulation Models of the joint ocean-atmosphere system. Various observational studies are shown to provide a useful starting point for diagnosis of climatic processes that may prove to be relevant to the CO_2 problem, but have certain problems and limitations that deserve comments.

4. Early detection strategies and monitoring of the ocean climate response, where it is suggested that early indications of CO_2-induced changes can perhaps be found in zonal-mean summer temperatures in the stratosphere and mesosphere, in satellite remote temperature sounding data, in the temperature of the deep ocean layers, in the weighted mean global mass integral of the atmospheric temperature or in the sea-ice extent. However, the early detection of the CO_2-climate signal requires not only a prediction of the CO_2-induced climate change but also a knowledge of the natural climate variabilities. Therefore, operational monitoring of the ocean and atmosphere is not only required but it is also necessary to determine from the past climatic records the variability of relevant climatic variables.

NRC Conclusions

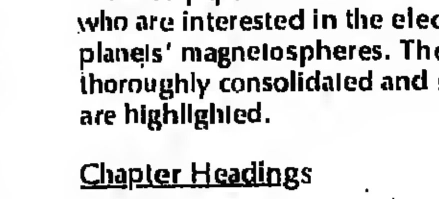
In summary, the panel reached the following conclusions.

(1) The sensitivity of global-mean temperature to increased atmospheric CO_2 estimated

A Broader Look

Estimating Future Levels

Books cont. on p. 54



Geophysical Monograph 28

MAGNETOSPHERIC CURRENTS (1984)

T. A. Potemra, Editor

MAGNETOSPHERIC CURRENTS $33

illustrations • hardbound • 375 pp.

The 37 papers in this volume are of value to scientists and students who are interested in the electric currents in the earth's and other planets' magnetospheres. The present research data in this field is thoroughly consolidated and summarized and remaining questions are highlighted.

Chapter Headings

- Early History
- Introduction to Magnetospheric Currents
- Surface Observations
- Near-Space Observations
- Distant Space Observations
- Ionospheric Effects
- Theory and Models
- Plasma Instabilities
- Current Systems in Other Magnetospheres

Write: American Geophysical Union, 2000 Florida Avenue, NW, Washington, DC 20009

Call: 800-424-2488 (202) 462-6903 (in DC area or outside contiguous USA)

Wire: Western Union Telex 710-822-9300

Orders under $50 must be prepaid

AGU members receive a 30% discount

Books (cont. from p. 53)

petrol rate and the present fuel mix is maintained. But, given the large uncertainties involved and only the two energy scenarios used, 2045 appears to be a reasonable estimate, which is diluted at the pessimistic side when compared with the more recent projections of about 2070. Furthermore, a worldwide warming will tend to produce a positive feedback releasing carbon from the soils, methane hydrates, and the oceans, although there remains uncertainty as to whether these large carbon pools will play a significant role in enhancing the CO_2-induced climate change.

Chapters 6, 8, and 9 review the fundamentals for simulating changes in the planetary heat balance from chemical changes in the atmosphere, considering models of the atmosphere in which radiation is the only mechanism by which energy is transferred. The equivalent quasigray radiative atmosphere gives a $\Delta T_s \approx 2.8$ K if the CO_2 content were doubled. A zonal energy balance model and a simple band model for infrared emission from the terrestrial atmosphere shows that the ΔT feedback from the additional water burden that the atmosphere can support in maintaining a constant relative humidity is comparable to the ΔT produced directly by an increase in CO_2. This illustrates the importance of the water vapor feedback which was clearly demonstrated by Ramanathan (*Journal Atmospheric Sciences, 38*(5), 918–930, 1981). The primary contribution to the 2 K CO_2 surface warming (2.3 K) is derived from the enhanced tropospheric IR emission due to the increased evaporation from the warmer ocean in a CO_2-rich atmosphere (1.7 K). This is an order of magnitude greater than the direct CO_2 radiative heating at the surface (0.17 K), the third process involved being related to the decreased component of the amplified atmospheric IR emission (0.3 K).

The addition to the atmosphere of minor constituents that absorb in the 8 to 12 µm band could also be important (chapter 7): An increase of [illegible] would place the [illegible] in the climate [illegible]; but both nitrous oxide and methane, which sit in regions where there is already strong absorption, factors of 2 are important. Although uncertainties do exist in the strength of future sources, in the atmospheric chemistry, and in the atmospheric feedbacks, an additional 1.5 K increase in average surface temperature is anticipated in the mid-21st century as a result of an increase by a factor of 2 in CH_4 (produced mainly from the anaerobic fermentation of organic material: 0.1 K), 1.5 in N_2O (from the use of ammonia based fertilizers: 0.4 K), 10 in freons (0.1 K), 1.5 in CO (a byproduct of the incomplete combustion of hydrocarbon fuels: 0.6 K) and 15 in [illegible] released from the electrolytic reduction of aluminum: 0.1 K).

Human Impacts

Finally, part 3 is devoted to some particularly important consequences of man's impacts on the composition of the atmosphere. After a short discussion on the use of models to predict climate (chapter 10), the latitudes dependence of the changing temperature is discussed (in chapter 11) with its effects on the distribution of sea-ice and, as a result, on the ocean circulation and on the marine biosphere. For example, an increase of the average ocean temperature by 4°C would ultimately release about one-seventh of the presently dissolved CO_2 content of the atmosphere and a polar, CO_2-induced warming will probably weaken the deep water pumps, although its sensitivity remains very hard to assess.

The impact of the warming on the most vulnerable part of the Antarctic ice mass, the West Antarctic ice sheet grounded below sea level, is then considered in chapter 12, a useful review of the basic physics of ice flow and creep being given in the appendix. On the basis of very simple mechanical considerations, the creep thinning of marine-based ice streams could be fast enough to draw down the ice sheet in as little as 100 years, but the question of whether a polar warming due to CO_2 doubling could remove ice shelves sufficiently to initiate such mechanical disintegration has no clear answer at the moment, but merits attention because of other crucial events triggered, namely the 5 m rise in sea level.

Finally, an increase in the CO_2 content of the atmosphere will increase the carbon that is available for fixation by photosynthesis and change the climatic conditions, both changes altering net primary productivity. The nonclimatic effects of CO_2 on agricultural and natural plants may be at least as important as the climatic effects and need better attention. For example, in addition to its possible effect as a fertilizer, the CO_2 produced by fossil fuel burning may also be helping to increase agricultural yields by reducing the water demand of crop plants in dry areas.

A summary ends this excellent book by focusing on

(1) the role of the biosphere in the carbon cycle (e.g., more detailed statistical analyses using observed climatic changes are required before the impact of climatic change on the biosphere can be predicted),

(2) the role of the soils and hydrates of methane,

(3) the role of climate models, intermediate in complexity between heat budget models (which cannot provide the details on the climatic parameters which are essential in assessing the long-term impacts on activities such as agriculture) and the global circulation models (whose complexity may hide the underlying physics and which related numerical approximation employed may distort the long-term interactions),

(4) the timing and place where rise in mean temperature will occur (summer or winter, night or day) and its effect on local extremes,

(5) the effort in monitoring trace constituents which can enhance the greenhouse effect,

(6) detecting the secular temperature trend against the noise background, and

(7) the worldwide nature of the CO_2 question.

Although the climate system possesses many resilient qualities, man's activities may well alter greatly the future climate and in consequence our society itself. It therefore behooves us to not let this experiment, the greatest inadvertent geophysical experiment ever begun, proceed unobserved and uncontrolled. These two books will undoubtedly help multidisciplinary interchanges among the overall community involved in this CO_2 problem. Read them.

A. Berger is with the Institute of Astronomy and Geophysics G. Lemaître of the Catholic University, B-1348 Louvain-la-Neuve, Belgium.

Seismic Reflection Interpretation

A. H. Kleyn, Applied Science, New York, xii + 269 pp., 1983, $57.50.

Reviewed by Larry D. Brown

This interesting, albeit uneven, little book reviews a broad range of topics related to the collection and analysis of seismic reflection data. In spite of its misleading title, it deals less with the geological interpretation of reflection sections than with the geometrical analysis of seismic raypaths. For example, statics corrections and migration theory—topics of peripheral interest if not indifference to most interpreters—are subjects of entire chapters while seismic stratigraphy, one of the hottest current branches on interpretation, is not even mentioned!

Title semantics aside, a glance at the table of contents confirms that most of the obligatory topics of an overview are covered: An introduction (chapter 1, brief to the point of extinction) is followed by a "Review of Basic Principles" (chapter 2) in which refraction, reflection, diffraction, Snell's Law, Fermat's Principle, Fresnel zones, reciprocity, sampling theory, travel-time curves and f-k filtering are variously, though curtly, discussed; chapter 3, "Geometrical and Analytical Backgrounds," gets to the ray tracing considerations which lie at the heart of this book, deriving time distance relationships for reflections and refractions in layered and continuous media as well as discussing CDP data collection technique, NMO and velocity analysis, and multiple reflections and areal surveys. "Static Corrections" are the subject of chapter 4, and chapter 5 ("Reflection, Transmission, and Acoustic Impedance") reviews basic concepts including a discussion of the convolutional model of reflection response and Gassman's equation for acoustic impedance in porous media. Chapter 6 ("Velocity Measurement in Wells") delves into well logging and its relation to seismic sections. Chapter 7 ("Structural Interpretation of Reflection Information") attacks the meatier topics of migration geometries in 2 and 3 dimensions, including time-to-depth conversion, and is supplemented in chapter 8 ("Elements of Signal Migration Systems") by a review of Kirchoff and finite element approaches to computer migration.

The book's primary appeal lies in its fresh presentation of considerations which have been either neglected or inadequately addressed in other texts. The flavor of industry experience enhances many of the treatments. The frequent incorporation of 3-dimensional considerations in discussion of analytical and processing procedures is especially welcome, although the 3-D diagrams are among the most confusing in the book, and the vector notation is abruptly introduced. The treatment of reflection time derivatives, examples of spurious reflections from such phenomena as reflected diffractions, time ties at line crossings, and the relationship between the various types of velocity measures are particularly insightful. Some relatively mundane topics like NMO stretch also receive an unusual airing. The overview of well logging is well done, with a discussion of well shooting as well as acoustic logging. The treatment of migration and structure is particularly thorough with respect to the geometrical aspects, including migration of time contour maps and 3-D data with the usual examples comparing unmigrated and migrated responses of basic structures. A discussion of migration before stack in chapter 8 also deserves mention. An especially useful aspect of this book is the inclusion of numerous exercises with solutions (referred to in the book as examples). These problems are unusually fresh and often more informative than the accompanying text. Also particularly handy are the numerous bibliographical references at the end of each section, although the use of volume numbers in lieu of page numbers is annoying. Lastly, the numerous seismic sections thumped, for some unexplicable reason, at the end of the book rather than inserted where they are discussed are excellent and exceedingly well reproduced.

Unfortunately, the treatment of many of these topics is uneven and often sketchy. According to the preface, the book is based on a series of industry lectures, which may account for the frequent impression of that one is reading supplementary notes rather than a fleshed-out text. Many of the basic relations are briefly derived, if at all, and important equations often appear with "it can be shown that"-type introductions. Although this brevity may have been an intentional effort to skirt introductory material which can be found elsewhere, the resulting incompleteness will impede readers not already familiar with the material. Many of the figures are unnecessarily confusing, usually because of poor annotation and incomplete discussion. To cite but one example: Explanation of how multiple channels are used to collect data in the CDP roll-along manner is relegated to a single, confusing figure of a stacking chart that would baffle anyone not already aware of how roll-along works. There are no true synthetic seismic sections (only travel-time sketches), although they would prove most informative in illustrating many of the principles. While such explanatory omissions might be acceptable when addressing an experienced industry audience, they seriously detract from this book's utility as a general purpose text.

Another detraction is the uneven and often curious emphasis of topics. Statics corrections are given a separate chapter, while all other aspects of seismic data processing are lumped under a background chapter. Even the discussion of statics is uneven: Much residual statics barely rates a mention. Resolution, deconvolution and anelastic attenuation are also barely mentioned. Although refraction is discussed at length, the traditional basic equations for interpreting thicknesses and dips in layered media never appear, except implicity buried in less useful (from the interpretation viewpoint) equations.

Even the more laudable discussions seem incomplete. For example, after expending considerable worthwhile prose describing various velocity measures, the author virtually skips through a discussion of the various methods for making such measurments, showing no examples of the most commonly used techniques such as velocity spectra. The computation of various time derivatives which I found rather elegant, is left hanging with no real attempt to point out their physical meaning or usefulness. The problem of vertical time-to-depth conversions seems to me to be unnecessarily entangled with migration aspects, without a clear explanation of the relationship. There is no mention of frequency domain migration although an entire chapter is devoted to Kirchoff and finite difference methods. Although several aspects of seismic data processing are addressed, the treatment is too scattered and incompelete to provide a useful overview of this aspect of reflection seismology. In spite of their excellent quality, the appended seismic sections are little discussed, except to illustrate a few rather limited points. Most of sections exhibit a number of interpretational principles worthy of much more discussion.

Although this book attempts to cover much of the methodology of the reflection seismology, it is too sketchy and uneven to serve alone as an introductory or reference text. Yet its treatment of selected aspects is too useful and novel to overlook. As a supplementary or perhaps refresher text, it is worth the attention of even experienced exploration geophysicists.

Larry D. Brown is with the Department of Geological Sciences, Cornell University, Ithaca, NY 14853.

AGU BUILDS ON ITS REPUTATION FOR VALUE WITH THESE 1984 JOURNAL PRICES

Geophysical Research Letters

Editor-in-chief is James C. G. Walker, Space Physics Research Lab, University of Michigan

Same price as last year

$22 (U.S.) $27 (Non-U.S.)

Geophysical Research Letters is published monthly. *GRL* contains reports of the latest research geophysics—papers are published 9 to 12 weeks after receipt of manuscript. *GRL* has only peer reviewed papers, with full author and subject indexes at year's end.

Reviews of Geophysics and Space Physics

Edited by James Heirtzler, Woods Hole Oceanographic Institution, and Andrew F. Nagy, University of Michigan

A 35% savings over last year

$18 (U.S.) $20 (Non-U.S.)

This journal, published quarterly, contains papers that distill previously published scientific work in currently active areas of geophysics and space physics.

Now all members can afford to have *Reviews of Geophysics and Space Physics* in their personal research libraries. This Union-wide journal of pertinent review articles has been specially priced.

TO PLACE YOUR 1984 SUBSCRIPTIONS TO EITHER OF THESE JOURNALS:

WRITE: American Geophysical Union, 2000 Florida Avenue, NW, Washington, DC 20009

WIRE: Western Union Telex 710-822-9300

CALL: 800-424-2488

(202) 462-6903 (local DC area or outside the contiguous USA)

E122083

AMERICAN GEOPHYSICAL UNION 800-424-2488 **PUBS-A-GRAM**

Need to order **Groundwater Hydraulics** (1983), edited by J. S. Rosenshein and G. D. Bennett. Latest edition in the **Water Resources Monograph Series.**

The 17 papers in this state-of-the-art monograph cover a broad range of hydrologic problems that are of immediate interest to the theoretician, academician, and applied hydrologist. The principal subject areas examined are aquifer hydraulics, heat and moisture transport, and modeling.

List price is $18—30% discount to all AGU members. Orders under $50 must be prepaid. Call 800-424-2488; or in DC area, 202-462-6903. [illegible] accepted.

هكذا من الأصل

Classified

RATES PER LINE

Positions Available, Services, Supplies, Courses, and Announcements: first insertion $5.00, additional insertions $4.25.

Positions Wanted: first insertion $2.00, additional insertions $1.50

Student Opportunities: first insertion free, additional insertions $2.00.

There are no discounts or commissions on classified ads. Any type style that is not publisher's choice is charged at general advertising rates. *Eos* is published weekly on Tuesday. Ads must be received in writing by Monday, 1 week prior to the date of publication.

Replies to ads with box numbers should be addressed to Box ___, American Geophysical Union, 2000 Florida Avenue, N.W., Washington, DC 20009.

For more information, call 202-462-6903 or toll free 800-424-2488.

POSITIONS AVAILABLE

Postdoctoral Fellowship: Hydrogeology. Applications are invited for a postdoctoral position at the University of British Columbia. Starting date: July 1, 1984; two years, with possible extension for a third year. Specific research task will require familiarity with hydrogeologic environments, contaminant transport, and numerical modeling. Open to candidates from Geology or Engineering. Salary: at least $20,700 Canadian. Applications with resumes and addresses of three referees should be sent to: Dr. R.A. Freeze, Department of Geological Sciences, University of British Columbia, Vancouver, B.C., Canada, V6T 2B4. For further information, telephone (604) 228-6162.

Research Position in Space Plasma and Auroral Physics. Two research positions at the level of assistant or associate research scientists are available in the Department of Physics & Astronomy at the University of Iowa for qualified candidates with a Ph.D. degree and experience in space plasmas and/or auroral physics. Present research in space plasma physics emphasizes analysis and interpretation of observations of magnetospheric plasmas using instrumentation on board earth-orbiting spacecraft in the IMP and ISEE Missions. The University of Iowa's global imaging instrumentation on the spacecraft Dynamics Explorer 1 is the source of an extensive data base of auroral images from high altitudes at visible and ultraviolet wavelengths. Photometric observations are also available for other areas of research including the physics of the upper atmosphere and the global distribution of atmospheric ozone. The applicant should identify and describe areas of his or her expertise which can support experimental or theoretical investigations in space plasma physics and/or auroral physics. Salary and position will be determined by the applicant's qualifications and experience.

A resume and the names of three persons knowledgeable of applicant's experience should be forwarded to: L. A. Frank, Department of Physics & Astronomy, University of Iowa, Van Allen Hall, Iowa City, Iowa 52242.

The University of Iowa is an affirmative action/equal opportunity employer.

Program Manager/Air-Sea Interaction. NASA Headquarters' Oceanic Processes Branch is seeking candidates for planning, developing and implementing a scientific research program utilizing satellite techniques in the general area of air-sea interaction. Specifically included is the use of satellite scatterometers to characterize the surface wind field, and the effect of surface winds on upper-ocean currents. Qualifications include 1) ability to communicate effectively, 2) demonstrated experience in conducting original research, 3) program management experience, and 4) knowledge of physical oceanography. GS 14/15, with salary ranges from $41,277 to $63,115, commensurate with experience/education. For further information regarding requirements and application procedures write to address below or phone 202-755-3687. Formal applications must be received by Mar 6, 1984.

NASA Headquarters, Code NHP, Washington, D.C. 20546.

An equal opportunity employer.

University of Oklahoma/Electronics Instrumentation Specialist. The School of Geology and Geophysics is accepting applications for a full-time Electronics Instrumentation Specialist. Principal responsibilities will include maintenance, calibration and user instruction for a new, computer-automated Rigaku XRD-XRF system, and maintenance and repair of electronic components of other lab facilities in the School. Additional opportunities could include involvement in the University's electron microscopy lab (SEM and TEM), and the development of a Van de Graaf-PIXE analytical system in collaboration with O.U. physicists. Applicants should have a B.S. in Geology, Chemistry, or Electrical Engineering or equivalent in experience; salary is commensurate with qualifications. Send curriculum vitae and names and addresses of three professional references to:

Dr. David London
School of Geology & Geophysics
University of Oklahoma
Norman, Oklahoma 73019

Deadline for applications is March 15, 1984.

The University of Oklahoma is an affirmative action/equal opportunity employer.

Assistant Professor of Geophysics/Purdue University. The Department of Geosciences, Purdue University anticipates an opening for a new tenure track position at the assistant professor level in the area of exploration geophysics. The successful applicant must be prepared to assist in teaching exploration geophysics courses, advanced topics in his/her specialty and demonstrate an ability to develop and conduct productive research. Postdoctoral or industrial experience is desirable. The geophysics programs in the Department of Geosciences at Purdue University currently consists of four full-time geophysics faculty. Field and laboratory equipment and facilities are available for application to seismological and potential field geophysical methods. Excellent computing facilities including a Cyber 205 computer operated by Purdue University and mini-computers within the Department of Geosciences are available.

Send letter of application including brief description of research interest and goals, resume and names of three references to:

Don W. Levandowski, Department of Geosciences, Purdue University, West Lafayette, Indiana 47907.

Closing date for acceptance of application is May 1, 1984 or until the position is filled.

Purdue University is an equal opportunity/affirmative action employer.

Clay Mineralogy/University of Illinois at Urbana-Champaign. The Department of Geology invites applicants for a tenure-track faculty position in clay mineralogy. We are seeking candidates who have clearly demonstrated the potential to be outstanding researchers in the general areas of mineralogy, crystallography and chemistry of clay minerals, in the origin, diagenesis, and metamorphism of argillaceous sediments and whose future research will complement our existing programs in the petrology and diagenesis of sediments, experimental studies of compaction and of kinetics of burial diagenesis, behavior of clay minerals during deformation, petroleum geology, and stable isotope geochemistry. In addition to the development of a strong research program, the successful candidate is expected to participate in all aspects of teaching and advising at the graduate and undergraduate levels.

The Department of Geology houses a variety of facilities for clay mineralogy research, including x-ray diffraction and fluorescence units, an atomic absorption spectrophotometer, two NMR spectrometers, an isotope-ratio mass spectrometer, and electron microprobes. Numerous other analytical services are available on campus, particularly at the Materials Research Laboratory where there is equipment for Auger electron spectrometry, x-ray photoelectron spectrometry, scanning electron microscopy, transmission electron microscopy, and ion microprobe studies.

This position is available immediately. PhD is required. Rank and salary will be commensurate with experience and qualifications. For equal consideration, please submit a letter of application that includes a statement of current and future research interests as well as a curriculum vitae, bibliography and the names of at least 3 references willing to comment on your qualifications and promise by April 1, 1984 to Dr. Albert V. Carozzi, Chairman, Search Committee, Department of Geology, 245 Natural History Building, 1301 W. Green Street, Urbana, IL 61801. Phone 217/333-3008.

The University of Illinois is an equal-opportunity/affirmative action employer.

Research Position/Department of Oceanography, University of British Columbia. Recent Ph.D. with experience in statistical methods and geophysical fluid dynamics sought to participate in the analysis and interpretation of data from an array of cyclesondes (profiling current meter, CTD system) and current meters in the Strait of Georgia. The candidate should also have the potential of modelling the observations in terms of the non-linear low frequency motion of a stratified fluid of variable depth. The position is available as of 1 November, 1984, for a duration of one year and may be renewed for a second year; it will be filled at postdoctoral (or $20,700) or research associate (up to or $27,000) level according to the candidate's experience. In accordance with Canadian immigration requirements, priority will be given to Canadian citizens and permanent residents of Canada. Resumes and three letters of reference should be sent 1 July 1984 to Dr. S. Pond, Dept. of Oceanography, 6270 University Blvd., Vancouver, B.C., Canada V6T 1W5.

University of Kentucky. The Department of Geology invites applications for two tenure track faculty positions. Areas of specialization are: 1) Geophysics, 2) Structural or Tectonic geology with some emphasis on geochemistry, geophysics, geomathematics or petroleum geology. It is anticipated that both positions will be filled at the level of Assistant Professor but applications for a more senior person will be considered. Degree of Ph.D. is required.

The Department awards BS, MS, and PhD degrees. The starting rank and salary depends on qualifications and experience—either industrial or academic.

Letters of application should include a full *curriculum vitae*, a statement of intent regarding research, names of three referees, and should be addressed to: Dr. Nicholas Rast, Chairman of Search Committee, Bowman Hall, Room 255, University of Kentucky, Lexington, KY 40506-0056, (606) 257-6222.

DEADLINE for application is *APRIL 15, 1984*

The University of Kentucky is an affirmative action and equal opportunity institution.

Seismologist/Virginia Polytechnic Institute and State University. The Department of Geological Sciences at Virginia Tech invites applications for an additional tenure track faculty appointment, at the junior level, in Reflection Seismology. Research facilities include a complete VIBROSEIS 48-channel seismic data acquisition system and a dedicated VAX 11/780 computer using DIGICON DISCO software.

Applicants must demonstrate a strong research record; preference will be given to those with experience in the theoretical and observational aspects of reflection seismology. Faculty members are expected to teach at both the undergraduate and graduate levels, supervise M.S. and Ph.D. theses, and conduct an active research program.

Applicants should send a resume and the names and addresses of three referees to:

J.A. Snoke
Department of Geological Sciences
Virginia Tech
Blacksburg, VA 24061

The appointment will begin September 1984 and candidates are expected to have completed requirements for the Ph.D. by that time. The application deadline is March 15, 1984.

Virginia Tech is an equal opportunity/affirmative action employer.

Mineralogical Society of America. Applications are invited for the position of Executive Secretary. The MSA Executive secretary is the member of the staff of the American Geophysical Union in Washington, D.C. who is responsible for managing the business activities of the Society. Duties include involvement in activities such as membership, accounting, publications, subscription fulfillment and meeting arrangements. Scientific, management, and/or publication background is desirable; dedication, organizational ability, and some knowledge of computer record management are essential. Salary from $23,000 depending on qualifications and experience. Send resume and names of three references to: Mineralogical Society of America, 2000 Florida Avenue, N.W., Washington, D.C. 20009.

Faculty Position/University of South Alabama. The Department of Geology and Geography is seeking to fill a tenure-track position at the Assistant Professor level, beginning September, 1984. Applicants should have major training and experience in geological application of remote sensing, and some phase of economic geology. The Ph.D. degree is required. This is a growing department with a present full-time faculty of five geologists and four geographers and approximately 200 majors. Please send resume and arrange for three letters of reference to be sent to: Dr. Glenn R. Sebastian, Chairperson, Department of Geology and Geography, University of South Alabama, Mobile, AL 36688. Applications should be sent before May 15, 1984.

The University of South Alabama is an equal opportunity, affirmative action employer.

Postdoctoral Position/Dalhousie University. A two-year position in the Oceanography Department is available for a person interested in marine geophysics. Specific work involves participation in heat flow studies across the margins of eastern Canada but broader opportunities also exist for self-motivated projects within the University or at Bedford Institute of Oceanography. A Ph.D. in geophysics and desire to work 1-2 mos/yr at sea are required. Experience with heat flow helpful but not essential. Send C.V. and names of two references to: Dr. K. E. Louden, Dept. of Oceanography, Dalhousie University, Halifax, NS, Canada, B3H 4J1.

Upper Atmosphere Research: USRA Visiting-Scientist/Research-Associate Program at NASA Marshall Space Flight Center. The Universities Space Research Association (USRA) invites applications for a research position in its Visiting-Scientist/Research-Associate Program at NASA Marshall Space Flight Center, Huntsville, Alabama, in the Atmospheric Sciences Division of the Systems Dynamics Laboratory. The research will consist of theoretical studies, data analysis, and modeling of the earth's neutral atmosphere above 70 km altitude in collaboration with NASA/MSFC scientists. While we particularly seek applications from recent graduates with the Ph.D. degree in atmospheric science, or a related discipline, consideration will also be given to holders of the Masters degree with appropriate experience. The appointment will be for one year (renewable); salary is competitive.

Applicants should submit a comprehensive resume and names of three references to Dr. M. H. Davis, USRA, P.O. Box 3006, Boulder, CO 80307. USRA is a non-profit consortium headquartered in Columbia, Maryland, sponsored by NASA contract.

The Association is an Equal Opportunity/Affirmative Action Employer.

Research Associates. The Department of Earth and Space Sciences at SUNY Stony Brook invites applications for a Research Associate position. Candidates should be experienced in application of Electron Microprobe and Analytical Electron Microscope techniques to geologic materials. The Department has a JEOL 200A Electron Microscope with EDS and will be purchasing a new Electron Probe in 1984. Duties will include equipment maintenance, instruction of graduate students on equipment use and research both independent and in conjunction with faculty. Familiarity with computers and Fortran programming required. A PhD is preferred. Salary is negotiable, but we anticipate a range of $18–24K.

Send letter of application, resume and names and addresses of three references by March 31, 1984 to Dr. Steven Bohlen, Department of Earth and Space Sciences, SUNY Stony Brook, NY 11794.

SUNY Stony Brook is an equal opportunity affirmative action employer. AK# 7-81

NASA/Space Plasma and Magnetospheric Physics. This is an opportunity to become involved in state-of-the-art data management issues, techniques, and solutions while simultaneously pursuing research interests. The National Space Science Data Center at the Goddard Space Flight Center is in an exciting transitional period and has three new openings on its contract staff for data oriented space plasma and magnetospheric physicists. These individuals will join with several others in attacking a broad range of activities primarily intended to facilitate access to and utility of space science data in an evolving technological environment. These activities include development of an online data catalog, interfacing with Principal Investigators and spacecraft project offices for data accessibility and documentation, preparing data catalogs, generating techniques for coordinated multi-spacecraft data acquisition and analysis, and generation of composite or other value-added data sets. Research interests are encouraged and may be pursued on a substantial part-time basis. A Ph.D. is preferred, although a Master's degree will be considered for some activities. Experience with space flight experiments, data analysis techniques, data presentation, publications, and programming is highly desirable. Specific duties will depend upon an individuals background and interests.

Send resume to:

Dr. H. Kent Hills
Sigma Data Services Corp., a M/A-COM Co.
Code 601
National Space Science Data Center
NASA/GSFC
Greenbelt, Md. 20771

Sigma Data Services Corp., a M/A-COM Co. is an equal opportunity employer.

To Do Today

Call AGU at 800-424-2488

- Order books/journals
- Request membership applications
- Register for meeting
- Place advertisement in Eos
- Change address

University of South Alabama. Faculty Position. Tenure-track position at the rank of Assistant Professor in one of the two following fields: (1) Invertebrate Paleontology-Stratigraphy, (2) Igneous OR Metamorphic Petrology. The University of South Alabama has approximately 10,000 students, and is located in a growing metropolitan area. The Department of Geology and Geography has approximately 200 majors, and a faculty of nine full-time and three part-time members. The position is to be filled commencing September, 1984. The deadline for applications is May 15, 1984. Please submit letter of application [illegible] experience, to: Dr. Glenn R. Sebastian, Chairperson, Department of Geology and Geography, University of South Alabama, Mobile, AL 36688. Also arrange to have at least three letters of reference sent to the same address.

The University of South Alabama is an equal opportunity, affirmative action employer.

Faculty Position/Florida Atlantic University. The Physics Department is seeking applications for an experimental physicist at a tenure line position at the Assistant Professor level beginning August, 1984.

Candidates must have a Ph.D. degree and have demonstrated a commitment to research and teaching. Preference will be given to candidates with experience in experimental atmospheric physics, optics, or solid state physics.

Salary is negotiable. Deadline for applications—April 1, 1984. Contact Dr. Bjorn Lundeen, Chairman, Department of Physics, Florida Atlantic University, Boca Raton, FL 33431. (Tel: 305-393-3381)

Florida Atlantic University is an equal opportunity/affirmative action employer.

Colgate University. The Department of Geology at Colgate University anticipates one or more openings in the teaching faculty beginning in the fall of 1984. These openings may include a full-time appointment renewable for a maximum of three years at the assistant professor level (Ph.D. required). A second position at the instructor level would involve primarily laboratory teaching. One position must be filled by a candidate capable of teaching undergraduate oceanography and/or physical geology. Areas of further expertise are presently less restricted and could include any of the following disciplines: Economic Geology, Engineering Geology, Geomorphology, Glacial Geology, Hydrogeology, or Marine Geology.

Applicants should submit a resume and the names of addresses of three references to Dr. Bruce Selleck, Department of Geology, Colgate University, Hamilton, NY 13346. Closing date for applications is March 15, 1984.

Colgate University is an equal opportunity/affirmative action employer and especially invites applications from women and minorities.

South Australia

THE UNIVERSITY OF ADELAIDE

invites applications from both men and women for the following position:

POSTDOCTORAL FELLOW IN APPLIED GEOPHYSICS

(S8805)

(FOR MATHEMATICIAN, PHYSICIST OR ENGINEER)

In the field of Airborne Magnetic Surveys. The position will be in the Department of Economic Geology which will be amalgamated with the Department of Geology and Mineralogy in 1985, to form a single Department of Geology.

The appointee will participate with Professor D. Boyd and a small research group in the development of a practical system of computer aided interpretation of digital aeromagnetic data which is being applied to problems in mineral exploration and geological studies.

Applicants should hold a PhD degree in one of the three fields of mathematics, physics or engineering, and should have used computing in post-graduate studies and be interested in solving complex real problems. Experience in Geophysics is an advantage, but is not essential.

The person appointed should take up the post before the end of June 1984. The appointment will be for one year in the first instance and, subject to the satisfactory performance of duties, will be extended for a further two years.

FURTHER INFORMATION on the duties of the position may be obtained from Professor D. Boyd — telephone (08) 228 5843 and Dr P. Brooker — telephone (08) 228 5842 or telex UNIVAD AA 89141.

FURTHER INFORMATION about the general conditions of the appointment may be obtained from the Senior Assistant Registrar (Personnel) of the University.

SALARY per annum: A$20,184 x 8 — A$23,100.

APPLICATIONS, IN DUPLICATE, quoting reference number and giving full personal particulars (including citizenship), details of academic qualifications and names and addresses of three referees should reach the Senior Assistant Registrar (Personnel) at the University of Adelaide, GPO Box 498, Adelaide, South Australia 5001, Telex UNIVAD AA 89141 not later than April 1, 1984.

The University reserves the right not to make an appointment or to appoint by invitation.

Air Force Geophysics Laboratory Geophysics Scholar Program (1981–1985). The Air Force Geophysics Laboratory (AFGL) and The Southeastern Center for Electrical Engineering Education (SCEEE) announce that applications are invited for research appointments during the 1981–1985 year in the Geophysics Scholar Program. This program provides research opportunities of 10 to 12 months duration for selected Engineers and Scientists to perform research in residence at the AFGL, Hanscom AFB, near Boston, Massachusetts. Scholars will be selected primarily from such fields as Geophysics, Atmospheric Physics, Meteorology, Ion Chemistry, Applied Science, Mathematical Modeling using Computers, and Engineering.

To be eligible, candidates must have a Ph.D. or equivalent experience in an appropriate technical field. Some appointments may be continued prior to August 1985 as such applications are encouraged. All qualified applicants will receive consideration without regard to race, color, religion, sex, or national origin. Application Deadline for September Appointments: August 1, 1984. For further information and application forms contact: SCEEE, 1101 Massachusetts Avenue, St. Cloud, FL 32769. Telephone: (305) 892-6146.

SCEEE supports Equal Opportunity/Affirmative Action.

Geophysicist/University of Minnesota. The Department of Geology & Geophysics invites applications for a tenure-track position at the assistant professor level starting fall 1984. We seek a Ph.D. and preferably some postdoctoral experience. The field of interest is open but includes, for example, gravity, magnetics, global and regional tectonics and the physical state of the crust and mantle.

Present research programs in geophysics include seismology, rock and paleomagnetism, mineral physics at high pressures, and crustal seismology. We also emphasize the interconnections of geophysics with the other strong programs in geophysics and isotope geochemistry, tectonics, and hydrology.

Please submit a letter of application and attach a curriculum vitae, a statement of research and teaching interests, a list of publications and the names of three to five references by March 15, 1984 to: Salm Baer, Department of Geology and Geophysics, 108 Pillsbury Drive, SE, University of Minnesota, Minneapolis, MN 55455.

The University of Minnesota is an equal employment opportunity affirmative action employer and encourages applications from qualified women and minorities.

Agricultural Drainage. Assistant, associate or full professor joint tenure track faculty position in the Department of Land, Air and Water Resources and Agricultural Engineering. Qualifications are a doctorate with at least one degree in engineering or related field. At least one degree in engineering desired. Applicants must have strong background in water flow and solute reactions in porous media, mathematical and computer simulation modeling, and course work and/or experience in engineering design and evaluation of agricultural drainage systems.

Teaching includes one undergraduate course: a background course in water and solute transport and descriptive treatment of drainage systems and a course in design and evaluation of drainage systems. Additional teaching duties include advising of undergraduate and graduate students. The appointee, after the research program is established, will be expected to offer a graduate course in that research area. Research involves study of processes in the management of soil salinity and shallow groundwater, including irrigated croplands.

Applicants should submit curriculum vita, transcripts, statement of research and teaching interests and background in each, copies of publications and manuscripts, abstract of dissertation and the names and addresses of at least three references to: Professor D. R. Nielsen, Chair, Search Committee, Department of Land, Air and Water Resources, 121 Veihmeyer Hall, University of California, Davis, California 95616, by March 30, 1984. Position is available immediately.

The University of California is an affirmative action/equal opportunity employer.

Space Plasma Theoretician/Princeton University. A postdoctoral position is available beginning summer of 1984 in the Theoretical Division of the Plasma Physics Laboratory, Princeton University, for one year with the possibility of renewal for a second year. Applicants with a Ph.D. degree or its equivalent in other relevant disciplines are encouraged to apply. The position involves theoretical and numerical simulation studies of space plasma physics under the support of the National Science Foundation. Interaction with the members of the Laboratory engaged in fusion plasma physics is encouraged. Interested candidates should send a résumé and three letters of recommendation to: Dr. H. Okuda, Plasma Physics Laboratory, Princeton University, Princeton, NJ 08544.

Princeton University is an equal opportunity/affirmative action employer.

College of Oceanography, Oregon State University/Two Faculty Positions. *Sediment Geochemist or Sedimentologist.* 12-month, tenure-track position as an Assistant or Associate Professor in the College of Oceanography. Ph.D. in earth science, marine geology, or marine geochemistry and strong potential or demonstrated ability to conduct grant-funded research required. The appointee will be expected to teach advanced courses in his or her specialty, supervise graduate student research, and develop a strong research program in marine sediments in at least one of the following areas: (1) mineralogy, (2) uranium series/radiochemistry, (3) stable isotope studies as applied to diagenesis, or (4) inorganic geochemistry.

Marine Geologist (Micropaleontology and Stable Isotopes). 12-month, tenure track position as an Assistant or Associate Professor in the College of Oceanography. Ph.D. in earth science, marine geology, or oceanography and have a strong potential or demonstrated ability to conduct grant-funded research required. The appointee will be expected to teach advanced courses in his or her specialty, supervise graduate student research, and conduct a strong research program in marine geology and stable isotopes with emphasis on paleoceanography and paleoclimatology. Send résumé and names of three references by April 15 1984 to:

G. Ross Heath, Dean, College of Oceanography, Oregon State University, Corvallis, Oregon 97331 U.S.A.

Oregon State University is an Affirmative Action/Equal Opportunity Employer and complies with Section 504 of the Rehabilitation Act of 1973.

Position in Geophysics (Applied Solid Earth)/University of California, Riverside. Visiting lecturer opening beginning 1 September 1984. Although the initial appointment will be as a Lecturer, and is annually renewable, the appointment could lead to a ladder faculty position the following year. Appointee would teach both undergraduate and graduate level courses in geophysics and tectonics. Ph.D. required, and evidence of excellent potential in basic research in any subfield of applied geophysics will be considered. In addition to teaching, research and service are required of faculty members at the University of California. Applicants should submit a current curriculum vita with names and addresses of three people who have agreed to provide references. Applications should be complete by April 1, 1984; however, late applications may be accepted until successful candidate is appointed. Send applications to: Dr. Shawn Biehler, Department of Earth Sciences, University of California, Riverside, California 92521.

The University of California is an equal opportunity/affirmative action employer.

Postdoctoral Position/University of Washington. Research Associate (postdoctoral) with background in physical oceanography or atmospheric sciences and interests in dynamical aspects of climate variability. Term of appointment: one (1) year, renewable for a second year subject to the approval of the Council. Closing date: March 15, 1984. Send curriculum vitae and a list of four (4) references to Director, JISAO, c/o Department of Atmospheric Sciences, AK-40, University of Washington, Seattle, WA 98195.

An equal opportunity/affirmative action employer.

POSITIONS WANTED

Mineralogist Geochemist. 31, Dipl., Ph.D., German, US permanent resident, visa, Lamar (Japan), igneous rocks and terrestrial, (sedimentation), metamorphic rocks pet petrographical geochemical geochronology, broad analytical experience (includes MS, INAA), research experience in US, English/French fluent, impressive publication record, seeks employment in research, industry or publishing business, no geographical restrictions. Please contact: Dr. Reinold, Inst. f. Mineralogy, Corrensstr. 24, D-4400 Münster, FRG.

STUDENT OPPORTUNITIES

Opportunity for Graduate Study in Igneous Petrology/Isotope Geochemistry—Southern Methodist University. The Department of Geological Sciences at Southern Methodist University in Dallas, Texas seeks outstanding individuals interested in a PhD program in igneous petrology and/or isotope geochemistry. The successful applicant should have a strong background in geology, chemistry, and mathematics and an interest in volcanic processes. Research will involve participation in a field-oriented petrological, geochemical, and isotopic study of Late Cenozoic volcanism in the Chilean Andes. For further details and applications please contact either:

Dr. R. S. Harmon (214) 692-3075
or
Dr. M. A. Dungan (214) 692-2752
Department of Geological Sciences
Southern Methodist University
Dallas, Texas 75275.

Meetings

1983 AGU Fall Meeting Report

In only 5 days the AGU 1983 Fall Meeting in San Francisco accommodated more than 3,100 attendees and more than 2100 papers. Each of the special all-union sessions attracted crowds of close to 1100 persons. Except for the 1982 Fall Meeting, which covered 8 days and included the American Society of Limnology and Oceanography (ASLO) Winter Meeting, 1983's was the largest AGU Fall Meeting ever.

The large number of presentations at the 1983 meeting was handled efficiently because many more than half of the papers to poster sessions, which were to many participants the highlight of the meeting. Poster presentations are becoming extremely good, and some of the more spirited sessions make many oral presentations seem pale in comparison. The sight of some of the world's leading geophysicists chatting over a poster paper with a student attested to one of the advantages of this type of presentation.

If you missed this meeting, plan early to attend the 1984 Fall Meeting, December 3–7, which will again include the ASLO Winter Meeting. It will be held in San Francisco at the Civic Auditorium.

Changes to the 1983 AGU Fall Meeting program and additional, late, and revised abstracts are printed below.

Papers Not Presented

F41-06, T. Scully.
A12-13, C. Gansch et al.; A12-14, W. H. Beadles et al.; A51-01, H. H. Siedman and C. A. Laurell, A51-03, D. G. Torr and M. R. Torr, A51-09, R. F. Shetter et al.; A52-11, S. A. McKeen.
G12-09, J. H. Kal, G51-13, R. E. Ziegler et al.
GP11-02, O. Orheim; GP11-11, J. L. Ros; GP14-03, B. M. Bubenik; GP41-06, E. K. Antonmehmann and D. L. Tin.
H12-01, P. M. Walls, H22A-13, F. H. Weibezahn, H41G-04, A. Mannogbor and J. L.

W. Geller; H31G-09, T. W. Schmid and H. D. Evans; H31G-12, A. H. Russell and E. G. Lappala; H31D-07, H. E. Kemp and J. T. Wells, H52A-02, C. L. Carnahan; H52B-04, C. Hebon and E. F. Wood.
O11B-07, A. Huyer; O11B-17, P. Flament et al.; H12B-15, J. M. Luck and K. K. Turekian; O21B-07, P. C. Fiedler; O22-15, N. G. S. Freeman; O31B-17, W. B. Owens and B. A. Warren; O31B-18, D. B. Boudra; O31B-22, J. N. Moum and T. R. Osborn; O31B-24, M. S. McCartney; O31B-27, S. L. Bennett et al.; O31B-31, D. L. Evans; O31B-33, G. Reverdin and M. Cane; O31B-34, T. B. McCord et al.; O31B-35, W. K. Melville and R. J. Rapp; O31B-36, H. B. Ahman; O41-04, J. N. Smith and K. M. Ellis; O42-14, J. T. Sam and W. B. White; O52B-07, C. C. Ebbesmeyer et al.; O52B-10, K. A. Pasoki et al.
P32-05, L. W. Esposito; P32-14, F. A. Kruse; P42-14, M. H. Bjorkman.
S11A-14, W. L. Ellsworth et al.; S11A-15, C. Vita-Finzi and G. G. P. King; S11B-28, D. S. Cavit et al.; S12B-02, S. P. Morris et al.; S21A-01, J. A. Collins et al.; S31-08, S. Gasse and M. Feller; S32B-04, M. V. Stong; S42A-08, G. Suarez and O. J. Perez; S42A-09, J. R. Kayal.
SA21A-02, S. Matsushita et al.; SA21A-05, M. O. Chandler and C. R. Chappell; SA21A-12, C. Hanuise and J. P. Villain; SA31-02, M. A. Blundi and D. P. Sipler; SA32-10, D. A. Gell et al.; SA42-04, A. L. F. Stewart; SA51-08, J. C. McConnell et al.; SA51-07, R. F. Daniell, Jr. and D. J. Strickland; SA52-18, J. Fahr et al.
SC11-07, D. Moses et al.
SM11B-03, B. Hausler et al.; SM12A-05, L. R. Lyons and D. S. Evans; SM12A-15, D. R. Parsignault et al.; SM41C-11, J. V. Olson; SM42A-01, J. L. Horwitz et al.; SM42A-08, D. W. Dalkowe et al.; SM51E-37, R. W. Spiro et al.
SS22-08, J. V. Hollweg and B. Roberts.
T22A-01, A. T. Linde et al.; T22A-05, R. B. Grannell et al.; T41C-21, B. G. Hairston and M. Y. Lee; T41C-32, J. Thune and R. Bell; T41C-33, M. F. Coffin and P. D. Rabinowitz; T42A-08, L. S. Chill; T42C-07, B. Johnson.

V11B-06, D. A. Sverjensky; V21B-03, R. K. O'Nions and E. R. Oxburgh; V21B-08, D. T. Eliathurai and P. D. Banks; V22B-07, R. Zhang; V31A-09, J. D. Friedman; V31B-02, G. Ivanson; V31B-07, P. J. Kupyllowski; V31B-13, J. Helgason; V32A-11, B. K. Julian and S. A. Sipkin; V41-02, R. B. Waitt, Jr. and N. S. MacLeod; V41-05, T. C. Pierson and K. M. Scott; V41-06, R. L. Rinehart; V42A-38, T. H. Pearce; V51B-13, M. S. Weathers et al.; V52B-09, J. D. Morris.

Late and Revised Abstracts

Atmospheric Sciences

A12-13 POSTER
Ex-situ Atmospheric Potential Measurements at 1.5 km

J. WOODLEY
R. HOLZWORTH (both at Geophysics Program, University of Washington, Seattle, WA 98195)

Continuous atmospheric potential measurements with the Hy-wire tethered balloon system have been made for duration of ~48 hours at 1.5 km altitude and with 10 min resolution at 1.1 km. Hourly averages of the 1.5 km data compare favorably to the Carnegie curve. The 1.1 km data show a similar diurnal pattern but with somewhat greater variation from the mean. Furthermore, a clear electric field variation with altitude is seen above a few hundred meters. Charge-discharge (ia) consistent measurements indicate that the Hy-wire source impedance is on the order of a few times 10^{10} ohm at both altitudes in agreement with earlier lower altitude measurements. A Carnegie-like pattern is shown by Hy-wire current measurements in the grounded mode, which have typical values of ~10 A during the potential minimum and ~30 A during the maximum. Ground-based E-field measurements with a field mill show an enhanced E-field in the vicinity of the apparatus in agreement with a simple electrostatic model of the wire.

Geodesy

G12-13
The 1982-83 El Nino and the Earth Rotation

T. M. Eubanks
R. C. Steppe
J. O. Dickey
A. L. Steppe (all at Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109)
R. D. Rosen, D. A. Salstein, Atmospheric and Environmental Research, Inc., Cambridge, Massachusetts

The 1982-83 El Nino was characterized by wide spread changes in the atmospheric and oceanic circulation. The southern oscillation index, a measure of the intensity of the El Nino, reached record lows in January, 1983. The period between December, 1982, and March, 1983, is also associated with highly anomalous changes in length of day (LOD) and the atmospheric angular momentum (AAM). The AAM reached a record high in late January, 1983, which is matched by an unusual peak in the LOD at the same time. These changes were due to a weakening of tropical easterlies and a strengthening of the mid latitude westerlies, especially in the northern hemisphere. At least 3×10^{25} kg m^2/s of eastward angular momentum was absorbed and then lost by the atmosphere during the period from mid January to mid February, 1983. Changes in the atmosphere mass distribution do not seem to have contributed significantly to the January, 1983, AAM anomaly. An evaluation of LOD data from the previous strong El Nino in 1972 shows no unusual LOD peaks. The relationship between the January, 1983, events and the anomalous changes of angular momentum will be discussed.

Geomagnetism and Paleomagnetism

GP22-21 POSTER
CRUSTAL MAGNETIC ANOMALIES IN CANADA

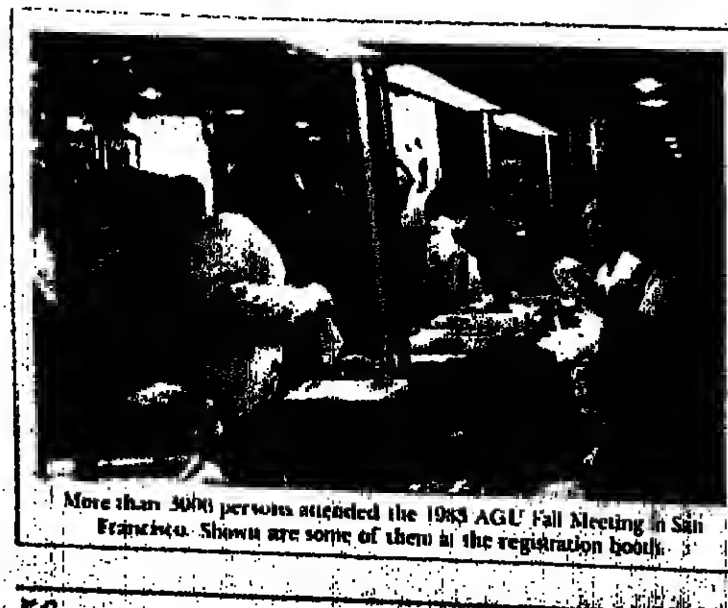
J. ARKANI-HAMED, M.E.S. URQUHART, D.W. STRANGWAY, (Department of Geology, University of Toronto)

The crustal scalar magnetic anomaly map of Canada and the northern United States, deduced from MAGSAT data is downward continued to 5 km altitude. The anomalies have no obvious correlation with tectonic provinces, but they do appear to correspond with certain types of sedimentary basins. Basins associated with old hot spots and intercontinental rifts have positive anomalies, whereas those in the centre of cratons have negative anomalies. Modern hot spots and mountain ranges also have negative magnetic anomalies.

GP41-11
R.G. Gupta, R.D. Hertz and P.A. Canfield (Division of Seismology and Geomagnetism) Earth Physics Branch, Ottawa, Canada, K1A 0Y3) (Sponsor: R.D. Hechbleder)

An Induction Anomaly on the West Coast of Vancouver Island

The geomagnetic data collected during the International Magnetospheric Study (IMS) interval between 1976–1980 at the Canadian stations located along the Churchill array are used to compute the transfer functions to investigate the conductivity structure in this region. [illegible]



More than 3000 persons attended the 1983 AGU Fall Meeting in San Francisco. Shown are some of them in the registration booth.

AGU President James A. Van Allen (left) presents the 1983 Walter H. Bucher Medal to John W. Harbaugh. [illegible]

Cynthia Bravo

1984 AGU SPRING MEETING
May 14–18
Cincinnati, Ohio
1 WEEK
ABSTRACT DEADLINE: February 22, 1984
For more information or to be placed on a special mailing list, write to 1984 Spring Meeting, AGU, 2000 Florida Avenue, N.W., Washington, DC 20009.
Call for Papers Published in Eos January 10, 1984

Hydrology

H22A-13 REVISION

Dynamics of Lateral Mixing of Waters from the Orinoco, Atabapo and Guaviare Rivers, in Southern Venezuela.

FRANS M. WEIBEZAHN (Instituto de Recursos Naturales, Universidad Simon Bolivar, Caracas, D.F., Venezuela) (Sponsor: Carl F. Nordin)

The waters of the Orinoco, Atabapo and Guaviare rivers, at their confluence at San Fernando, are markedly different in their chemical composition, as well as in their suspended sediment concentrations. According to Sioli's classification of South American river waters, they fit into the clear, black and white water rivers, respectively.

A quantitative study was undertaken to measure the lateral mixing of these waters, at their rising stage, June 15–19, 1983. Measurements were made at cross sections, one at each river mouth and 4 along the main stem of the Orinoco, downstream from the confluence. Samples were taken at 3 points on each of the 7 cross sections. Water, at each sampling location, was taken with an integrating bottle, from the surface to one meter above the bottom. Surface temperature, pH and conductivity were measured at the field sites, and alkalinity, NO_3-nitrogen, total dissolved phosphorus, total dissolved phosphorus, NH_4-nitrogen, conductivity, dissolved organic carbon, pH and temperature in a laboratory [illegible]

Structure and geometry of the channel had a marked effect on the mixing rate of the 3 river waters. Transverse mixing was slow and the results of the measurements and analyses of suspended sediments, alkalinity, total dissolved phosphorus, NO_3-nitrogen, conductivity, dissolved organic carbon, pH and temperature fit a Cartesian [illegible] approximately 100 km below their confluence, just above where the Vichada River comes in, the Orinoco, Atabapo and Guaviare waters had not yet fully mixed.

Tour drilling sites were approximately 28.5 km, 11 km, 18.8 km, and 4.8 km. The sediments at these sites were dominantly nannofossil oozes with varying proportions of iron oxide-rich clay most of which is probably hydrothermal in origin. The base of each sediment section contains chalks which are not of hydrothermal origin. Pore waters showed no evidence of present-day hydrothermal advection through the sediments. The oldest site, 597, was re-entered and drilled 90 m into basement with 53% recovery. The basalts were rather fine-grained to coarse-grained, basically massive flow units, and have undergone at least three stages of alteration. Leg 92 also returned to Site 504B for a suite of downhole experiments including conventional geophysical logging and a seismic experiment using a borehole seismometer as a receiver. Preliminary results suggest considerable anisotropy in fracture patterns around the hole. Downhole temperature logging showed that downhole flow forced by underpressure has decreased in 5-years and that the bottom hole temperature is now about 165–168°C. Water sampling showed extensive formation of borehole waters with either the basalts or the drilling mud in the hole.

O11-11

Trace Gases in the Blanco Trough and on the Gorda Ridge

M. D. Lilley, J. A. Baross and L. I. Gordon (all at College of Oceanography, Oregon State University, Corvallis, OR 97331)

The Blanco Fracture Zone which connects the Juan de Fuca and Gorda Ridges is comprised of numerous troughs with the largest and deepest being the Blanco Trough (44° 20'N, 130° 0'W).

Vertical profiles of O_2, N-nutrients, CH_4, H_2 and N_2O were taken in the Blanco Trough in June, 1982. Compared to concentrations at similar depths at a station removed from the trough(s) area (30°N, 134°W), O_2 was reduced by approximately one-half within the trough. CH_4 was a factor of two higher within the trough except very near bottom where it was undetectable. H_2 concentrations were similar at both stations. The reduced gases and nutrients all showed considerable vertical structure in near bottom samples within the trough.

A series of near bottom hydrocasts were also made during a general survey for hydrothermal activity on the Gorda Ridge in August, 1980. One of these stations (42° 06'N, 127° 09'W) exhibited CH_4 concentrations an order of magnitude above the ambient deep value in the lower 400 meters, indicating that the cast may have been in the vicinity of an active vent.

Ocean Sciences

O11B-12S

Reduced Trace Gases under Low Oxygen Conditions in the Water Column of Saanich Inlet, British Columbia

M. A. de Angelis, J. A. Baross, M. D. Lilley (all at College of Oceanography, Oregon State University, Corvallis, OR 97331)

The reduced gases H_2, CH_4, CO and N_2O, as well as O_2, NO_3, NH_4, NO_2, NH_4^+, ATP and denitrification potential (acetylene blockage technique) were measured throughout the water column of Saanich Inlet, British Columbia in October, 1982 and in February, April, August and September, 1983. Sampling was concentrated in the mid-water column where low O_2 (~20 µM) conditions prevailed. A high degree of variability in the reduced trace gas and nitrogen species concentrations was observed in this region and is believed to reflect variable production/consumption mechanisms for these gases and nutrients. Correlations were observed among H_2 maxima (5.7 to 18.1 nM), high denitrification potentials (123 to 181 nmoles N_2O/l/day) and ATP maxima (202 to 489 pM). Additionally, the coincidence of O_2 and CO maxima (2.5 to 8.0 nM H_2; 6.1 to 27.8 nM CO) as well as H_2 and NH_4 maxima (~2.2 to 8.0 nM H_2; 1.6 to 65 nM NH_4) may be the result of "consumption" mechanisms involving CO_2 and NH_4 respectively. The data suggest that the mechanisms regulating the distributions of these gases and nitrogen nutrients in Saanich Inlet may be controlled by O_2 concentrations at low O_2 levels (0.2 to 20 nM O_2).

O12A-13A POSTER

The California Coastal Current Program

PLUTCHAK, NOEL B. and ROBERT J. TAIT (Raytheon (5126 Ralston St. Ventura, CA. 90099)

Under the sponsorship of Bureau of Interi Mineral Management Service, an extensive pro of measurements in the coastal waters of cer California (Point Conception to San Franc area) is beginning in November 1983. measurement components are: 1) Time ser measurements of current speed and direct pressure, temperature and conductivity at moo sites selected to best capture the flow patt indicated by the results of historical stud These have characterized the large scale feat of the region as a number of flow reg approximately paralleling the trend of the co 2) Near-synoptic hydrographic lines run rou normal to the coast at intervals along the c of 50 km and extending offshore to about 70 2) Continuous current profiles along hydrographic tracks using a ship mounted dop acoustic meter. 3) Near-synoptic aerial map of the surface (100 feet ASL) wind and tempera fields and the surface radiant water tempera over a limited geographic area in the vicinit Point Conception during the hydrogra measurements in that area. 4) Aerially me Lagrangian motion along the hydrographic l during the time of hydrographic work and als the locations of pertinent small scale sur motions shown to exist by satellite imagery.

Historical and ancillary data from other sou in the region will be collected into the data for guidance in the sampling design and comparison with the sea-going results. particular winds from the coastal sites, one and offshore will be analyzed for their influ on shifts in the current structure.

An advisory committee and workshops will convened to guide the program.

O21A-19

Influence of Hydrothermal Emissions on Environment in Santorini and Milos Islands (Cyclades, Greece)

J. N. VALETTE-SILVER (C.N.R.S.-Universite de Perpignan, 66000 France, and Carnegie Institution of Washington, D.C.)

The chemistry of live hot springs situated on islands from the Cyclades were studied. They are located on land or at sea, on the bottom of bays or fractures on Santorini-Nea Kameni (Eterna and Megalior, Milos (Theioriwaln and Mavrugrosal and Kimolos (Thermopotral). The chemistry of the springs shows the strong participation of seawater in the hydrothermal fluid. Compared to standard sea water, Fe, Mn and SiO_2 are always in excess in the springs with Fe/Mn ratios varying from 5 to 10. At the interface between hydrothermal fluids and sea water, strong precipitation occurs. The new material formed is predominantly amorphous to cryptocrystalline and is composed of Fe and SiO_2 with Fe/Si ratios varying from 2 to 3. At sea, variations in the composition of seawater, rocks and sediments surrounding the mouth of the hot spring depend mostly on the pH and chemistry of the hydrothermal fluid. For example, on Milos in the Theiorisvin Hot Spring, the pH is very low (2.8) and the waters exhibit the highest concentrations of dissolved Fe and Mn of the live springs studied. The sediments surrounding the vents are also very rich in Mn, with the crystals observable as detrital grains. On the contrary in Santorini, where the pH of emission is higher than 5, Ca and S are frequently associated with Fe and SiO_2 in the water sediments.

On land, fumaroles and hot springs modify the surrounding material. For example, in comparison to the unaltered rocks, SiO_2 and K are always depleted, whereas metals such as Cu or Mn are often enriched.

O21A-20

HYDROGEOLOGIC STUDIES ON THE SOUTHEAST PACIFIC: PRELIMINARY RESULTS OF DSDP LEG 92

M. LEINEN, (Graduate School of Oceanography, University of Rhode Island, Narragansett, RI 02882-1197)
D.K. REA (Department of Atmospheric and Oceanic Sciences, University of Michigan, Ann Arbor, MI 48109)
LEG 92 SHIPBOARD SCIENTIFIC PARTY

Leg 92 completed multidisciplinary hydrogeologic studies of seven sites on the Pacific to examine the controls on past and present hydrothermal processes. Six new sites, Sites 597–601, were drilled in four areas which form an E-W transect on the west flank of the East Pacific Rise at 19°S. Basement ages of the

042-01 REVISED

Argon 39: The first deep profile! (Continued....)

H.CRAIG, R.HIH (Scripps Institution of Oceanography, UCSD, La Jolla, CA 92093).
H.H. LOOSLI, U. WEIMAN, P. KALT (University of Bern, CH-1012 Bern, Switzerland).

The first depth profile for ^{39}Ar (a cosmic-ray produced "non-transient" tracer, mean-life = 388 years = 5% of radiocarbon mean-life) was reported for surface, 250 m, and 600 m depths of the N. Pacific Geosecs 1 Station, two years ago (Craig, Hih, Loosli, Oeschger, EOS 61, 812, 1980). We now have data (also for ^{85}Kr) at depths of 0, 150, 250, 400, 600, and 4200 m (possibly more by AGU time!). Samples for each depth consist of 600 cc(STP) of Ar, stripped from 2 tons of ocean water; ultimately a 10 depth profile, representing 20 tons of water, will be completed. At 600 m the ^{39}Ar activity is 40% of "modern" (defined as atmospheric and surface water activity). At 4200 m depth we observe a ^{39}Ar activity = 17% of modern (the counting rate/sample here is 0.02% of that for radiocarbon measurements, which gives an idea of the effort involved). The ^{14}C "hurry age" (exponential decay time) for this water is 1800 years, which gives a predicted ^{39}Ar activity 9 ± 4% of 0.95 modern (vs. 17% measured). For a simple two-box mixing model, however, the radiocarbon data give a deep water residence time (at Geosecs 1) of 2118 years; in this model the predicted deep water ^{39}Ar activity is 15% of modern. Reasons for this, and other models will be discussed. ^{85}Kr will be compared in the upper waters; at 4000 m the activity is less than 0.1 dpm/ccKr, indicating no air contamination (< 0.8%) in the sample. Although the 250-kg-sample Gerard barrels of ... lame no longer exist, we fortunately have two more Pacific profiles (intact) for measurement. The audience will be asked to rise and face toward Seattle for a moment's silent meditation at the close of this talk, in tribute to the late Gerard Barrels which have made their final deep cast: the longest one of all. Sic transit gloria maris!

O11A-14A

Modeling Storm-Driven Currents in the Santa Barbara Channel

R. B. Gordon (Exxon Production Research Co., Houston, TX 77001)

The response of the Santa Barbara Channel to storm winds was investigated using a two-dimensional (x-z), two-layer numerical model. The model has a surface mixed-layer that entrains according to a velocity dependent parameterization, and a lower layer in which the density varies linearly with depth.

The passage of a storm that occurred in February, 1959, was simulated in detail in order to illustrate the highly non-linear response resulting from large displacements of the thermocline and from the entrainment process. For this storm, estimates of the long-shore barotropic pressure gradient were available from calculations conducted at the University of California, Santa Barbara, using a three-dimensional model covering a large section of the California shelf surrounding the Channel.

In this simulation, it was necessary to increase the depth of the nearshore grid cells in order to prevent the thermocline from intersecting the bottom. The effect of this artificial deepening was estimated qualitatively by using Csanady's linear coastal jet theory for a channel with arbitrary depth variations.

Because the entrainment rate is such a highly non-linear function of the mixed-layer depth and the velocity difference between layers, the sensitivity of the computed solution to uncertainties in the initial and forcing conditions and to grid resolution and horizontal eddy viscosity was investigated.

Seismology

S11B-37 POSTER

Seismic Recordings Containing Frequencies in the Audio Range

E. CRANSWICK (U.S. Geological Survey, 345 Middlefield Road, Menlo Park, CA 94025)

Frequencies as high as 100 Hz are present in the seismograms of recent aftershocks of the January 9, 1982 Miramichi, New Brunswick earthquake. Both sources and receivers of these seismograms recorded in July 1983 are located within the boundary of a granitic pluton that underlies the aftershock zone. This high frequency phenomenon was observed at ranges of less than 10 km at six different stations all of which were equipped with three-component 2 Hz velocity transducers sited directly on basement outcrop and recorded by GEOS digital seismographs sampling each component at 500 sps. Some records show resonances at about 68 Hz and 100 Hz on the vertical and horizontal components respectively; these high frequencies are absent in records made with identical instrumentation at a site at which the transducer was separated from the basement rock by roughly ten meters of low velocity surface sediments. A smaller data set of three-component digital records sampled at 1200 sps per channel recorded at a seventh hard-rock site shows a high frequency limit at about 100 Hz.

The presence of these high frequencies indicates that the exposed crystalline rocks are characterized by low anelastic attenuation. This observation is in accord with the reports of sounds associated with earthquakes in northeastern North America. Furthermore, the difference between the resonant frequency of the vertical components and that of the horizontal components suggests that seismic waves at these high frequencies interact with some small scale (tens of meters) structures such as exfoliation joints within the outcrop.

EOS
FOR ACTION

When you want fast advertising results, you want Eos.

Eos delivers. Every Tuesday of every week Eos is read by over 16,000 geophysicists worldwide.

Advertising in Eos results in accelerated sales and recruiting.

For low advertising rates and copy deadlines, please call: Robin E. Little 800-424-2488.

S12B-18A

Evidence for Lowermost Mantle Heterogeneity from LASA

C. A. Powell (Department of Geology, UNC-Chapel Hill, Chapel Hill, N.C. 27514)

Array determined azimuth of approach, ... values for teleseismic events occurring at distances exceeding 90° agree favorably with values predicted by the new model for lower mantle heterogeneity determined by Dziewonski (1983). Agreement was noted for two large arrays located in the western U.S., LASA and Hanford. Predicted ... anomalies calculated using the Dziewonski model agree in sign and relative magnitude with ... anomalies calculated for LASA for nine out of ten globally distributed ray paths. LASA ... anomalies are always larger in absolute magnitude but this is to be expected as the Dziewonski model produces a low pass filtered view of the velocity perturbations. Disagreement is greatest for ray paths originating in southern Russia. Additional near array lower mantle structure is needed to explain the LASA and Hanford ... anomalies associated with this source region. The overall excellent agreement between LASA and predicted anomalies suggests that additional, unambiguous information concerning lower mantle heterogeneity can be derived from the LASA array diagram.

SPR: Aeronomy

[illegible]

Observations of an Ionospheric ... Following the Coalinga Earthquake of 2 May 1983

J. H. Wolcott (Atmospheric Sciences Group, Earth and Space Sciences Division, Los Alamos National Laboratory, ...)
D. J. Simons (Atmospheric Sciences Group, Earth and Space Sciences Division, Los Alamos National Laboratory, Los Alamos, NM 87545)
D. D. Lee (SRI International, Menlo Park, CA 94025)
R. A. Nelson (SRI International, Menlo Park, CA 94025)

At 23:42:38.5 GMT on 2 May, 1983, a moderate earthquake occurred approximately 13 km northeast of Coalinga, California. The Rayleigh wave generated by this earthquake coupled enough energy into the atmosphere to generate a pressure pulse that created a large scale traveling ionospheric disturbance. This disturbance was detected by an ionospheric monitoring network at five locations that were separated from the earthquake epicenter by between 160 and 261 km. These observations are the first ionospheric disturbances to be reported this close to an earthquake epicenter.

SPR: Cosmic Rays

SC21-11

Observations of the E-W Asymmetry of Solar Flare ESP Events by the IMP-7 and 8 s/c.

E.C. TRICHOUTSAS, E.T. SARRIS, G.C. ANAGNOSTOPOULOS (Democritos Univ. of Thrace, Xanthi, Greece)
S.M. KRIMIGIS (JHU/APL, Laurel, MD)

Observations of energetic-ion intensity enhancements (E > 290 keV) associated with solar flare generated shock waves (solar flare ESP events), obtained during nearly a decade by the APL/JHU instruments on board the earth orbiters IMP-7 and 8, are incorporated in this work in order to examine the role of the large scale shock morphology with relation to the upstream interplanetary magnetic field in the formation of these ESP events. It is shown that a clear East-West solar hemisphere asymmetry is present in the distribution of the ESP relative intensity enhancements with respect to the heliolongitudes of the shock wave source-flare sites. The large low-intensity enhancements superimposed on the ambient solar flare ion population are preferentially associated with solar flare sites located to the East of the spacecraft Meridian, whereas on the average only weak ESP events are associated with solar flare sites to the West of the spacecraft Meridian. The observed asymmetry and its implication on the dominant processes for the generation of the solar flare ESP events are discussed on the basis of the presented extensive survey.

SPR: Magnetospheric Physics

SM11B-08A

Implications of Steady State Particle Entry for the AMPTE Program

V. P. OLSON (McDonnell Douglas Astronautics Company, Huntington Beach, CA 92647)
B. A. PFITZER (McDonnell Douglas Astronautics Company, Huntington Beach, CA 92647)

Studies using realistic magnetic field models have shown that KeV particles can enter the magnetosphere even when it is magnetically closed. This form of charged particle entry proceeds at all times and influences many steady state magnetospheric processes. This entry mechanism is present because when magnetosheath particles impact the magnetosphere, they encounter a gradient in the magnetic field parallel to the magnetopause. Their subsequent motion in such a structured magnetic field allows some of them to permanently enter the magnetosphere. Because of the symmetry of the magnetospheric magnetic field, the flux of entering particles is zero along the noon-midnight meridian plane. The entry flux is largest near the equator along the flanks of the magnetopause and also occurs in the dayside cusp regions.

This entry model suggests that the AMPTE release near the subsolar point will place the tracer ions near the region of minimum entry. As the ions move through the sheath and are dispersed down the dawn flank of the magnetosphere, the entry rate will increase. The motion of the ions after entry will depend on both magnetic and electric field structure. It is expected that the most likely path for the ions after entry will be to drift across the near tail region to move along field lines into the polar ionosphere. The ions that drift along the tail may, however, drift all the way around the earth. It is possible that a spacecraft near ... will ... the ... ions ... their release.

[illegible]

Transmission of ... Ions through the Earth's Magnetosphere

L. C. Lee and ... (Geophysical Institute, University of Alaska, Fairbanks, Alaska 99701)

[illegible]

[illegible]

Numerical Simulation of the Tearing-Mode Instability in an Anisotropic Neutral Sheet

J. I. Ambrosiano (Berkeley Scholars, Inc., P.O. Box 852 Springfield, Virginia, 22150)
L. C. Lee and Z. F. Fu (Geophysical Institute, University of Alaska, Fairbanks, Alaska 99701)

A parametric study, utilizing a magnetoinductive particle simulation, is performed to evaluate the tearing-mode stability properties of a field-reversed plasma layer with an anisotropic temperature distribution ($T_\perp/T_\parallel$). Distributions with $T_\perp > T_\parallel$ are shown to greatly enhance the linear growth of the instability, while those with $T_\perp < T_\parallel$ are strongly stabilized. The simulation results are consistent with the results of Laval and Pellat[1] based on the energy principle, and the recent linear analysis of Chen and Palmadesso[2]. A surprisingly small amount of anisotropy evidently produces a large effect. The nonlinear phase of the simulations is influenced by a variety of conditions including the length and width of the simulated region; however, the conversion from magnetic to kinetic energy is in each case enhanced by a $T_\perp/T_\parallel$ anisotropy.

1. G. Laval and R. Pellat, ESRO SP-36,5 (1968).
2. J. Chen and P. Palmadesso, "Tearing Instabilities of an Anisotropic Neutral Sheet", submitted to Phys. Fluids (1983).

Tectonophysics

T32E-01 REVISION

Microseismic Measurements of V_p and Q_p^{-1} on an Alkalic Basalt Melt: Indirect Detection of Viscosity Values

Meetings (cont. on p. 58)

Meetings (cont. from p. 57)

[illegible]

Volcanology, Petrology, and Geochemistry

[illegible]

V12A-14A Depositional ramps of the Ata pyroclastic flow deposit in southwestern Japan

Y. SUZUKI and T. UI (Department of Earth Sciences, Faculty of Science, Kobe University, Kobe 657 Japan)

[illegible]

(1) Suzuki, Y. and Ui, T. (1982) Geology, 10, 429-432.

V12A-16 INVIT

Chemical and isotopic composition of the Casa Diablo hot springs: magmatic CO₂ near Mammoth Lakes, CA

[illegible]

Assessing Nuclear Explosions

The all-Union session on the Geophysical and Geochemical Consequences of Nuclear Explosions at the 1983 AGU Fall Meeting attracted a large audience, and many were unable to find a seat or standing room. The speakers and questioners emphasized the complexity of the processes and the need to extend the computer models. In particular, the global-circulation models presented by scientists from the National Center for Atmospheric Research showed that smoke/dust clouds should cause major changes in the weather systems with great contrast between the temperature perturbations over oceanic, coastal, and continental regions. Important developments in the models and conclusions can be expected over the next few years as AGU members from many disciplines contribute their skills. On behalf of the Public Affairs Committee, I want to thank all the speakers at San Francisco for their excellent presentation on a difficult subject.

This meeting report was prepared by Joseph V. Smith, who is with the Department of the Geophysical Sciences, University of Chicago, Chicago, IL 60637.

Latin American Geomagnetism Workshop

Modelers of the earth's magnetic field look to the network of magnetic observatories to provide information on secular change. Others, studying the shorter period variations, want the observatories to provide digital, machine-readable data. Whatever the application, whether it be the data base for the International Geomagnetic Reference Field, time extrapolation for satellite surveys, or magnetospheric current studies, all users want more from the observatories than is presently available, especially from that part of the world composed largely of developing countries. Money might solve some of the problem, but it is generally unavailable. However, there are other factors, some of which are more amenable to solution.

In an attempt to improve the data base, there has been proposed a series of regional workshops, bringing together the operations people and the users to discuss problems and solutions. The first of these was the Workshop on Latin American Geomagnetic Observatory and Survey Practice held at the Observatório Nacional in Rio de Janeiro, October 16–22, 1983. There were 45 participants from 15 countries of Latin America, North America, and Europe. The stated objective was to improve the quality of the Latin American geomagnetic programs by informing the participants of the state of the art in the various areas of geomagnetic work; discussing common problems and their solutions; promoting information exchange by personal contact among the participants; providing information which might assist in strengthening the bases of national programs; and encouraging participation in international programs.

The following topics were covered: observatory operations, field surveys, magnetic instruments, field modeling, magnetic cartography, uses of magnetic data, and national and international programs. There were formal papers and round tables; papers were delivered bilingually, in English and Spanish or Portuguese. Several important needs became apparent during the proceedings. These were put in the form of resolutions, including the encouragement of geomagnetic research on regional phenomena; periodic checks of observatory standards against the International Magnetic Standard; the desirability of digital recording; improvement in opportunities for training and exchange of personnel and information; and closer collaboration with IAGA and the World Data centers.

Positive steps were taken by participants toward establishing new observatories in some of the data gap areas. All agreed it would be appropriate to have another workshop in 5–10 years.

This workshop was sponsored jointly by the Sociedade Brasileira de Geofísica, the Observatório Nacional, the Pan American Institute of Geography and History, the Inter American Geodetic Survey, the Instituto Geofísico del Perú, World Data Center "A" in Boulder, Colo., and the International Association of Geomagnetism and Aeronomy. Co-organizers were J. S. Lorenzo of the Brazilian society, L. M. Barreto of the Observatório Nacional, M. Casaverde of the Peruvian institute, and K. L. Svendsen, representing World Data Center "A".

The Observatório Nacional is planning to publish transactions of the workshop. Papers will be in the language of original presentation and abstracts will be available in at least English and Spanish. Distribution will be to the attendees, to those Latin Americans who were invited but could not attend, and to magnetic observatory operators throughout the world. Inquiries may be directed to L. M. Barreto, Director, Observatório Nacional, Rua General Bruce No. 586, São Cristóvão, 20921 Rio de Janeiro, Brazil.

This meeting report was contributed by K.L. Svendsen, who is with World Data Center A, Boulder, CO 80303.

Actions at Hamburg

International Association of Seismology and Physics of the Earth's Interiors

Officers

President: Ziro Suzuki (Japan); First Vice-President: St. Müller (Switzerland); Second Vice-President: A. V. Nikolaev (USSR); Secretary-General/Treasurer: R. D. Adams (UK)

Executive Committee

B. A. Bolt (USA); E. R. Engdahl (USA); C. Froidevaux (France); E. G. Kausel (Chile); Xu Shao-xie (China)

Commission Chairmen

Commission on Controlled Source Seismology H. Shimamura (Japan)
Commission on Earthquake Hazards *Committee on Earthquake Hazard Assessment:* M. J. Berry (Canada); *Committee on Earthquake Prediction:* F. F. Evison (New Zealand)
International Heat Flow Commission A. E. Beck (Canada)
Commission on Microseisms J. Darbyshire (UK)
Commission on Physical Properties of Materials of the Earth's Interior T. J. Ahrens (USA)
Commission on Practice E. R. Engdahl (USA); N. V. Kondorskaya (USSR)
Commission on Quantitative Seismology H. J. Neugebauer
Commission on Seismological Theory J. H. Woodhouse (USA)
Commission on Strong Motion Seismology B. A. Bolt (USA)
Commission on Wave Propagation in Real Media S. Crampin (UK)
European Seismological Commission H. Stiller

UNESCO/IASPEI Working Group on a Code of Practice for Earthquake Prediction

In recent years, a number of earthquake predictions have been made, both by individual scientists and by institutions, some of which have proved successful and some have been unsuccessful. The former resulted in the saving of human life and the reduction of material losses. Others have been unsuccessful but their publication has led to serious disruption of economic and social activity in the areas affected by the predictions.

The successful prediction of earthquakes is an important scientific objective, and research in this field should be actively encouraged, but it is clear that scientists who are engaged in such research, and who find themselves in a position to make predictions, must bear an unusual degree of social responsibility.

Ill-considered release of a prediction to the public domain may have grave social consequences; on the other hand, a successful prediction may be instrumental in saving many lives but only if it leads to appropriate and well-organized response by the community concerned.

Following an agreement reached between UNESCO and IASPEI, a Working Group on a Code of Practice for Earthquake Prediction met in Hamburg August 12–13, 1983. A list of the participants appears at the end of this report.

Given the wide variety of social structures within which research on earthquake prediction is conducted in various countries, the task of defining a Code of Practice having universal validity is one which will require wider study. In drafting this code, however, the meeting regarded its task not as one of defining a code of ethics, but rather of recommending guidelines for the more effective formulation, evaluation and communication of earthquake predictions for the benefit of society.

Code of Practice for Earthquake Prediction

The objectives of this code of practice are as follows:

1. To ensure that scientific earthquake predictions are put forth in such a way as to favor constructive social response.
2. To encourage seismologists to undertake research in the broad field relevant to seismogenesis and earthquake prediction.
3. To assist the development of earthquake prediction as a means both of testing hypotheses of seismogenesis and of mitigating earthquake risk.
4. To prevent scientific predictions being confused in the public mind with predictions not based on scientific observation and reasoning.
5. To promote international cooperation and goodwill in the area of earthquake prediction.

Formulation of Predictions

Considering that research of earthquake precursors is now progressing from the stage of data collection towards the stage of hypothesis-testing, it is recommended that predictions be formulated in terms of probability, i.e., the expectation, in the space-time-magnitude domain, of the occurrence of an earthquake. The strength of the predictive statement is then represented by the increase in the expectation, compared with that prevailing before the prediction was made.

As a prediction develops in the course of continuous monitoring of the region, the expectation may be progressively modified on the basis of further precursory data or other relevant occurrences, so that the prediction process itself becomes continuous. Likewise the performance of the hypothesis can be continuously reassessed. The region being monitored will in general include areas of reduced expectation as well as areas of increased expectation, and the prediction as a whole can, if appropriate, be readily adopted as a basis for designing or modifying earthquake countermeasures in the region.

Scientific Evaluation of Predictions

Earthquake predictions need to have adequate support from within the seismological community before being considered acceptable as a basis for the formulation of warnings. Scientists should therefore seek to have predictions confidentially reviewed by their scientific colleagues and should ensure that such support is forthcoming before making them more widely known.

In countries where organizations have been set up or designated for the purpose of the scientific evaluation of predictions, scientists who wish to put forward predictions should submit them to the relevant organization.

Scientific editors who are considering the publication of papers containing earthquake predictions should take special precautions to ensure that adequate support from within the seismological community has been obtained for these predictions.

Communication to the Public and Public Authorities

Experience has shown that disorganized and counterproductive public response may arise from the direct communication of an earthquake prediction to the news media. The news media are generally not the appropriate means by which to announce a prediction. The author of a prediction should instead communicate the prediction confidentially to the governmental authority designated or best able to deal with such predictions.

At all times, scientists should exercise extreme care and restraint in communicating directly with the news media since the matter potentially affects the safety and socioeconomic stability of the population in the designated area.

Predictions Concerning Foreign Countries

Recognizing the serious problems that may arise from the prediction by scientists in one country of an earthquake that may affect another country, it is recommended that:

1. Originating scientists and scientific editors should give careful consideration to the potential social and political effects of a prediction concerning a foreign country.
2. Every effort should be made to involve scientists of the affected country or region cooperatively in the prediction effort and in the evaluation of specific predictions.
3. Appropriate scientists and governmental officials of the affected country should be advised of the prediction effort at the earliest opportunity, should be kept informed of the continuing research, and should be notified of the results sufficiently in advance of their public release to allow for response by the affected government.

Recommendations for Further Action

1. Considering that not all countries have earthquake prediction evaluation bodies, it is recommended that UNESCO, in collaboration with IASPEI, establish an international earthquake prediction evaluation panel or roster of experts which, upon request, will be available to assist any country in the evaluation of earthquake predictions.
2. Recognizing that scientists in one country may need to communicate predictions to appropriate authorities in another country, it is recommended that UNESCO request each member state to designate an authority to receive earthquake predictions emanating from other countries and to take any appropriate action.
3. Recognizing the importance of objectivity, reproducibility, and reliability of predictions it is recommended that UNESCO and IASPEI be requested to convene workshops on algorithms for earthquake prediction and evaluation.
4. Recognizing the importance of recent applications of probability theory and exploratory data analysis to the formulation and evaluation of earthquake predictions, it is recommended that UNESCO and IASPEI be requested to convene an international meeting on this subject.
5. Since earthquake predictions will be effective in reducing human and material losses only if they are followed by appropriate concerted action to reduce vulnerability in the affected areas, it is recommended that UNESCO and UNDRO undertake a detailed study of the problems arising in the response to long, medium, and short term earthquake predictions by civil defense and other relevant organizations.

Meeting Participants

C. R. Allen (USA); F. F. Evison (New Zealand); F. M. Fournier d'Albe (France); A. Giesecke M. (Peru); V. I. Keilis-Borok (USSR); C. Lomnitz (Mexico); G. Mader (USA); T. Rikitake (Japan); Xu Shao Xie (China). *For UNESCO:* M. Hashizume (France).

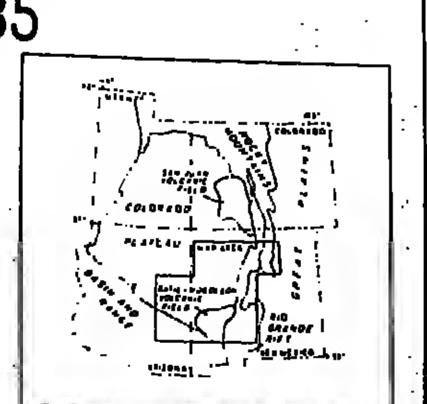
AGU SPECIAL

Book and Map
COMBINATION DISCOUNT
$35

RIO GRANDE RIFT: TECTONICS AND MAGMATISM (1979)
Edited by R. E. Riecker

"It is in the successful exposition of studies of all ... aspects of rifts that Rio Grande Rift is outstanding ... The papers in the book are likely to become standards against which future rift studies can be measured."
Science

This comprehensive overview compiles important papers from the international Symposium on the Rio Grande Rift. [illegible]



Geologic map of the Rio Grande Rift and Southeastern Colorado Plateau, New Mexico, and Arizona (1983) by W. S. Baldridge, Y. Bartov and A. Kron

This map indicates the geologic and structural relationships among the varied tectonic elements of the Rio Grande Rift and adjacent Colorado Plateau and Basin and Range Provinces.

- Full color
- 36" × 46" (91 cm × 117 cm)
- Referenced and annotated
- 2 sided
- Side one is printed on a mosaic of Landsat images.
- Side two reference map is printed on a USGS base map.

$15 list

30% DISCOUNT TO AGU MEMBERS

[illegible]

Announcements

Women Engineers and Scientists

The Baltimore-Washington section of the Society of Women Engineers will host the 1984 International Conference of Women Engineers and Scientists in Washington, D.C., June 17–24, with women from more than 30 countries expected to attend and participate in technical and professional seminars.

The theme for the conference will be "Technology—An International Bridge." Among the topics will be transportation, education, agriculture, computers, communications, energy, and medicine. Professional development sessions will also be held, focusing on the problems facing women in technical fields, the fulfillment of career goals through continued education, and management versus technical careers. For more information, contact Rosemary Markle, 9122 Battle St., Manassas, VA 22110; telephone 703-642-0035.

Groundwater Quality

The Second International Conference on Groundwater Quality Research, sponsored by the National Center for Groundwater Research and the U.S. Environmental Protection Agency, is scheduled for March 27–29 in Tulsa, Okla. The emphasis of the conference will be on the physical, chemical, and biological processes that control the movement and fate of contaminants in the subsurface. Papers have already been selected on topics including investigative methodology, biological and nonbiological transformations, sorption, and transport processes.

Early registration for the conference closes March 1. For further information, contact Norman Durham or Ann Redells, University Center for Water Research, Oklahoma State University, 203 Whitehurst, Stillwater, OK 74078; telephone 405-624-6995.

GAP

Separates

To Order: The order number can be found at the end of each abstract; use all digits when ordering. Only papers with order numbers are available from AGU. *Cost:* $3.50 for the first article and $1.00 for each additional article in the same order. Payment must accompany order. Deposit accounts available.

Copies of English translations of articles from Russian translation journals are available either in unedited form at the time of their listing in EOS or in final printed form when a journal is published. The charge is $2.00 per Russian page.

Send your order to:
American Geophysical Union
2000 Florida Avenue, N.W.
Washington, D.C. 20009

Electromagnetics

0720 Electromagnetic Theory

NON-SPECTRAL REPRESENTATION FOR THE FIELD OF A HORIZONTAL WIRE ABOVE GROUND

M.P. Carpentier (Centro de Análise e Processamento de Sinais, Complexo Interdisciplinar, Instituto Superior Técnico, Av. Rovisco Pais, 1096 Lisboa Codex, Portugal), A.F. dos Santos

A representation in error functions for the current and field of a horizontal wire above [illegible]

[illegible]

0799 General Electromagnetic Properties

A DETAILED [illegible] STUDY OF THE JEMEZ VOLCANIC ZONE, NEW MEXICO

Mark P. Ander [illegible] Los Alamos National Laboratory [illegible]

The Jemez volcanic zone is an alignment of late Cenozoic volcanic centers located in northern New Mexico and Arizona. [illegible]

[illegible]

0930 Seismic methods

SOUND SPEED AND ATTENUATION MEASUREMENTS IN GASSY [illegible]

[illegible]

Exploration Geophysics

[illegible]

0930 Seismic methods

THE NATURE OF SEISMIC REFLECTIONS FROM DEEP CRUSTAL FAULT ZONES

[illegible] Jones and Amos Nur (Rock Physics Project, [illegible] Stanford, California 94305)

[illegible]

0930 Seismic methods

TRAVEL TIME INVERSION OF OFFSET [illegible]

[illegible]

0930 Seismic methods

THE MIGRATION OF COMMON GEOPOINT SLANT STACKS

[illegible]

Announce it in Eos

- Positions Available
- Special Meetings
- Services
- Student Opportunities
- Supplies

Read every week by 16,000 AGU members worldwide, Eos meets your advertising needs.

For advertising rates and copy deadlines, please call: Robin E. Little, 800 424-2488.

E102583

theoretical [illegible] is that there is no exact treatment of lateral velocity variations.

Slant stack migration is a method of "migration before stack." It solves the dip selectivity problem of conventional stacking, particularly when horizontal reflections intersect steep dipping reflectors. [illegible]

essential whenever the ratio of source offset to layer depth becomes small. Traveltime inversion also requires careful estimation of layer velocities and proper static corrections. Aside from these difficulties and the ubiquitous nonuniqueness problem, the VSS traveltime inversion was able to produce a valid earth model for tests on a real data case.
GEOPHYSICS, VOL. 45, NO. 1

Geochemistry

1410 Chemistry of the Atmosphere
BAYESIAN PROBABILITY CALCULATIONS FOR STRATOSPHERIC OZONE MODIFICATIONS
Lane Bishop (Allied Corporation, 20 Peabody St., Buffalo, NY 14210) and William J. Hill

A methodology is described for combining current information on ozone perturbations obtained from chemical model calculations and ozone trend analyses. This approach, known as Bayes analysis, yields probabilities for different amounts of change in total column ozone and ozone in Umkehr layer 8 (near 40 km). An examination is made of the sensitivity of the results to two different chemical models, and uncertainties involved in chemical model and trend analysis estimates. (Ozone trend analysis, ozone chemical model calculations).
J. Geophys. Res., D, Paper 4C0491

1410 Chemistry of the atmosphere
PHOTODISSOCIATION RATES OF MOLECULAR OXYGEN IN THE TERRESTRIAL ATMOSPHERE: SIMPLIFIED EMPIRICAL RELATIONS FOR THE SPECTRAL REGION OF THE SCHUMANN-RUNGE BANDS
Marcel Nicolet (Ionosphere Research Laboratory, The Pennsylvania State University, University Park, PA 16802)

A numerical method is presented for modeling the photodissociation of molecular oxygen in the spectral range 175–200 nm of the Schumann-Runge bands in the terrestrial atmosphere. It is possible to obtain realistic photodissociation rates that are in good agreement with detailed and complete calculations by using the following simple formulae. [illegible]

isotopic tracer to geological processes. Owing to the low abundances of ^{138}La and ^{138}Ce in nature, our measurements of $^{138}Ce/^{140}Ce$ ratios of natural samples have relatively large (>0.01%) errors, and the variations in Ce-isotope ratios were barely resolved. A tenuous anticorrelation was observed between ϵ_{Ce} and ϵ_{Nd} for terrestrial basalts and granites, indicating that with some improvement in analytical techniques the Ce isotopic composition may prove useful as a tracer for geological processes. A very low ϵ_{Ce} predicted from the Ce anomaly in the REE pattern of the Khohar L3 chondrite (Nakamura and Masuda, 1973) was not observed in this study, indicating that the Ce anomaly may be caused by terrestrial contamination or alteration. A low ϵ_{Ce} estimated for the source of Nakhla is consistent with our previous estimate (Nakamura et al., 1982) of a LREE depleted source. (Ce isotopes, La–Ce, Ce anomaly, meteorites).
J. Geophys. Res., B, Paper 3B5026

1400 Miscellaneous (Io's Surface)
EROSION AND MODIFICATION OF SO_2 ICE BY ION BOMBARDMENT OF THE SURFACE OF Io.
R.E. Johnson, L.J. Lanzerotti, W.L. Brown, L.A. Barton (Engineering Physics, University of Virginia, Charlottesville, Va. 22901), W.L. Brown (Bell Labs, Murray Hill, N.J. 07974)

We report measurements of total yields, energy spectra and mass spectra of molecules sputtered from SO_2 ice at low temperatures by keV Ar^+ ions. These measurements are applicable to corotating sulfur and oxygen ion sputtering of SO_2 on Io. We find that the yields are much larger than those estimated earlier for low energy ion sputtering of SO_2 and the energy spectra are peaked at lower energies than expected. We observed the irradiation time dependence of the chemical alteration of fresh SO_2 leading to the production of new molecular species and identify masses 32 (O_2 or S), 48 (SO), and 80 (SO_3 or S_2O) as ejected species in addition to SO_2. These measurements are used to determine the rate of direct sputter ejection of sulfur into the Jovian plasma torus, the rate of erosion of patches of SO_2 ice, and estimates of the surface column densities of SO_3 in SO_2 ice produced by the corotating and fast ions. We estimate that the direct sputter ejection rate of sulfur to the Jovian plasma is of the order of 10^{10} atoms/cm^2/sec, that the erosion rate of fresh SO_2 deposits due to sputtering is of the order of 10^{-1} cm/year, and that only for penetrating ion bombardment can a significant, and possibly observable, column density of SO_3 be produced in an SO_2 frost.
J. Geophys. Res., A, Paper 3A1211

Geomagnetism and Paleomagnetism

Hydrology

Geomagnetism and Aeronomy
Volume 23, Number 1

Brief Informations

Letters to the editorial board

Chronicle

was small and short-lived. (Silviculture, watersheds, peak flow, suspended solids).
Water Resour. Res., Paper 3W1994

3125 Glaciology (Ice core analyses)
TROPICAL GLACIERS: POTENTIAL FOR ICE CORE PALEOCLIMATIC RECONSTRUCTIONS
L. G. Thompson [illegible]

3130 Groundwater
EVALUATION OF THE SKIN EFFECT IN SLUG TESTS
Charles O. Faust and James W. Mercer (GeoTrans, Inc., 209 Elden Street Herndon, Virginia 22070)
Hydraulic properties for low-permeability formations are often estimated using slug tests. If the well in which the tests are conducted was drilled with drilling [illegible]

3130 Groundwater
OPTIMAL ANNUAL OPERATION OF A COASTAL AQUIFER [illegible]

3140 Limnology (Irradiance distribution)
A METHOD FOR COMPARING SCALAR IRRADIANCE MEASUREMENTS WITH UPWARD AND DOWNWARD IRRADIANCE IN LAKES [illegible]

3170 Snow and Ice
INSOLATION TOPOCLIMATES AND POTENTIAL ABLATION IN ALPINE SNOW ACCUMULATION BASINS: FRONT RANGE, COLORADO [illegible]

3170 Snow and Ice
AN OVERVIEW OF PASSIVE MICROWAVE SNOW RESEARCH AND RESULTS [illegible]

3175 Soil Moisture
THE OPERATIONAL SIGNIFICANCE OF THE CONTINUUM HYPOTHESIS IN THE THEORY OF WATER MOVEMENT THROUGH SOILS AND AQUIFERS [illegible]

3720 Climatology
THE ORIGIN AND EARLIEST STATE OF THE EARTH'S HYDROSPHERE [illegible]

Meteorology

3710 Boundary layer structure and processes [illegible]

3790 Instruments and Techniques [illegible]

3793 General (Precipitation Patterns)
SOME FEATURES OF GROUND RAIN PATTERNS MEASURED BY RADAR IN NORTH ITALY [illegible]

3715 Chemical Composition and Chemical Interactions [illegible]

3799 General (Numerical Weather Prediction) [illegible]

3713 Chemical Composition and Chemical Structure [illegible]

Atmospheric and Oceanic Physics
Volume 19, Number 2

Atmospheric and Oceanic Physics
Volume 19, Number 3

Physics of the Solid Earth
Volume 19, Number 4

Oceanography

Loop Current in the fall of 1980 and moved into the western Gulf of Mexico. Inertial wave currents observed from satellite-tracked drifters show that typical speeds of the near-surface currents associated with this ring are about 50 cm/s. There is also a surprising amount of higher frequency current fluctuations. These include diurnal and semi-diurnal tides, a basin tidal resonance, and a free gravity mode.
J. Geophys. Res., C, Paper 4C0115

4715 Circulation
A MODEL FOR THE ANALYSIS OF DRIFTER DATA WITH AN APPLICATION TO A WARM CORE RING IN THE GULF OF MEXICO [illegible]

4715 Circulation
LAGRANGIAN OBSERVATIONS OF AN ANTICYCLONIC RING IN THE WESTERN GULF OF MEXICO [illegible]

Particles and Fields—Interplanetary Space

Particles and Fields—Ionosphere

Particles and Fields—Magnetosphere

5111 Electric Fields
EFFECTS OF OBLIQUE DOUBLE LAYERS ON UPGOING ION PITCH ANGLE AND GYROPHASE
M. B. Brosenpen (Johns Hopkins University, Applied Physics Laboratory, Laurel, Maryland 20707)

Observations of electrostatic shocks above the auroral zone, of upgoing ion beams which show evidence of both parallel and perpendicular acceleration, and of ion conics suggest that the shocks play a role in the energization of the beams and, perhaps, of certain conics. To investigate shock effects on ions, I follow the trajectories of many ions through a very simple model of an oblique double layer, a narrow region of strong electric field with components both parallel and perpendicular to the magnetic field. Acceleration through the model oblique double layer produces gyrophase bunching, and hence density oscillations. Although it arises from a model which is not self-consistent, this result shows that a consistent oblique double layer model must include temporal variations and/or spatial oscillations in the density or electric field. The oblique double layer increases both the perpendicular and the parallel energy of ions. The amount of perpendicular energization is greater for O+ than for H+, in agreement with observations. I examine the parametric dependence of perpendicular energization on initial ion energy, angle between the electric and magnetic field, and width of the potential structure. (Electric fields, double layers, shocks)
J. Geophys. Res., A, Paper 4A0145

5770 Interactions between solar wind and magnetosphere
RESONANT ALFVEN WAVES EXCITED BY A SUDDEN IMPULSE
W. Baumjohann (MPI für extraterrestrische Physik, 8046 Garching, W-Germany), H. Junginger, G. Haerendel and O.H. Bauer

On March 6, 1979, long-period hydromagnetic waves were excited in the forenoon magnetosphere by a sudden impulse (SI). The plasma drift velocity and magnetic field oscillations associated with these waves were observed by the electron gun experiment and the magnetometer, respectively, onboard the GEOS-2 satellite in the equatorial plane. The waves had both compressional and transverse components and had their probable source in a single tailward travelling large-scale magnetopause surface wavelet caused by the passage of an interplanetary shock front. This surface wavelet apparently coupled into the inner magnetosphere via the field line resonance mechanism. The satellite observations and the Poynting vectors calculated from these are consistent with a location of the resonance region earthward of GEOS-2 during the first 5 min after the SI while the satellite was located just inside the resonance region at later times. This shift in the relative location of the resonance region has its probable cause in an increase of the Alfvén velocity due to the compression of the magnetosphere associated with the sudden impulse. (Plasma motion, short period variations of magnetic field).

... nia, 90024), R. L. McPherron and T. Terasawa

Dependence of the power spectrum of Pc 3-4 magnetic pulsations observed at the ATS 6 geosynchronous satellite on the interplanetary magnetic field (IMF) has been studied. Pulsation events that were observed near noon and exhibited harmonic structure are chosen for analysis. We further select pulsation events with identical fundamental frequency to study dependence of the power of pulsations at different harmonic bands on the IMF. A weak negative correlation is observed between the IMF cone angle θ_{XB} and the power of pulsations in the frequency range 20-70 mHz. Also, a positive correlation between the intensity of the IMF (B_{IMF}) and the power of pulsations at 30-70 mHz is found. This B_{IMF} control is present at all ranges of the cone angle. We compare this observation with the frequency of bow-shock-associated upstream waves predicted from a model of wave generation by a cyclotron resonance of ions reflected at the bow shock. The predicted frequency depends on the IMF as $B_{IMF}\cos^2\theta_{XB}$. Although this relation gives a proportionality between the frequency and B_{IMF} qualitatively consistent with the observation, it does not explain the most obvious IMF control of the spectrum of the pulsations. (Interplanetary magnetic field, magnetic pulsations).
J. Geophys. Res., A, Paper 4A0036

5775 Particles and Fields—Magnetosphere
INTENSE LOW ENERGY ION POPULATIONS AT LOW EQUATORIAL ALTITUDES
D. J. Williams (The Johns Hopkins University, Applied Physics Laboratory, Johns Hopkins Road, Laurel, Maryland 20707), L. A. Frank

The combined data from the ISEE-1 medium energy and plasma instruments have identified the existence of surprising spectral structures in the trapped ion population at low equatorial altitudes, $2 \lesssim L \lesssim 4$ and $\alpha_{eq} \approx 10°$. By analyzing our instruments' responses at the limits of their capabilities, we are able to resolve a double peak structure just below the instruments' energy overlap region (20-40 keV). Two narrow $(\frac{\Delta E}{E} \sim 0.4)$ energy peaks are observed. We conclude that the higher energy (HE) peak is composed of protons and that the lower energy (LE) peak is made up of singly ionized ions (H^+, He^+, O^+). At $L \sim 3$ the HE peak is located at ~ 17 keV and the LE peak at ~ ? keV. The energy of the peaks increases as L decreases and the intensity of the peaks is ~ ? ions/cm² sec ster keV. Orbit geometry and available data recordings allowed these ions to be observed for the six month period November 1977 through April 1978 and over the local time range ~0300-1500 hours LT. These characteristics plus charge exchange lifetimes pose severe boundary conditions on possible source and injection mechanisms. Of those considered, ion cyclotron acceleration of thermal ions in the presence of an anisotropic energetic population appears a likely source of these quasimonoenergetic peaks. Additional peaks in the energetic ion spectra are observed at energies $\gtrsim$ 40 keV. Some of this higher energy structure may be related to cross-L diffusion of multi-component ion populations.
J. Geophys. Res., A, Paper 4A0066

Physical Properties of Rocks

AGU MEMBERS
Does your library subscribe to the Antarctic Research Series?

6110 Elasticity, fracture, and flow
EFFECTS OF COMPRESSION DIRECTION ON THE PLASTICITY AND RHEOLOGY OF HYDROLYTICALLY WEAKENED SYNTHETIC QUARTZ CRYSTALS AT ATMOSPHERIC PRESSURE
M. F. Linker (U.S. Geological Survey, 345 Middlefield Road, Menlo Park, California, 94025), S. H. Kirby, A. Ord, and J. M. Christie

A hydrothermally grown synthetic quartz crystal with 370 ± 60 ppm hydroxyl impurity was cut into eight rectangular prisms in eight crystallographic orientations. We compressed the prisms under constant axial force corresponding to a uniaxial stress of 140.6 ± 0.5 MPa, and temperatures of 310 and 750°C. All but one of the samples sustained permanent axial strains of 2 to 3%. We established the operating slip systems from specimen shape change, slip bands and dislocation etch pits on polished surfaces, crystallographic orientation changes, stress-optical features in thin sections, and from transmission electron microscopy. The observed creep behavior and plasticity divided the samples into three groups: (1) Crystals compressed at 45° to [0001] and [11̄10] and those compressed ⊥[10̄11] and ⊥(01̄11) deformed principally by slip parallel to [0001]. Creep rates were relatively high and were not strongly sensitive to test temperature. Dislocation arrays approximately parallel to [3̄110] are common. Dislocation loops are elongate parallel to [0001], indicating that the edge segments were more mobile than the screw segments. (2) The second group of samples were loaded normal to [0001] in three orientations: ⊥[12̄10], ⊥[101̄0], and at 45° to [1̄100]. These samples deformed primarily by {101̄0} ⟨a⟩ slip with some evidence for secondary slip on the other systems. They were more creep resistant than the first group and displayed a much higher sensitivity of creep rate to test temperature. Dislocation loops are very elongate parallel to [0001], indicating that the screw dislocation segments were much more mobile than the edge segments. (3) A sample compressed parallel to [0001] at 750°C crept at a barely detectable rate ($\sim 10^{-9} s^{-1}$) and no optical-scale slip features were observed. These results confirm our earlier work on one orientation each from groups (1) and (2) which indicated a strong creep anisotropy for this same crystal. This creep anisotropy parallels a remarkably similar anisotropy in the diffusivity of impurities in quartz, suggesting a causal relationship between impurity diffusion and creep associated with hydrolytic weakening. (Quartz, synthetic quartz, rheology, hydrolytic weakening).
J. Geophys. Res., B, Paper 4B0125

6110 Elasticity, Fracture, and Flow
EXPERIMENTAL DEFORMATION OF TOPAZ CRYSTALS: POSSIBLE EMBRITTLEMENT BY INTRACRYSTALLINE WATER
K. V. Lee and S. H. Kirby (U.S. Geological Survey, 345 Middlefield Road, Menlo Park, CA, 94025)

Crystallographically oriented single-crystal prisms of gem quality topaz (composition $Al_2SiO_4(OH_x F_{1-x})_2$ where x = 0.4 ± 0.01) were deformed at a confining pressure of 1.50 GPa, a temperature of 800°C, and a strain rate of $2 \times 10^{-5} s^{-1}$. Under nearly identical ...

... all and tholeiitic basalt compositions, respectively. If this interpretation is correct large regions of the Beta-Phoebe area are likely to be characterized by lava flows. The relative freshness of features observed by Venera 14 suggests that some bedrock surfaces are geologically young, or that erosion rates are low. (Venus, Venera, geomorphology).
J. Geophys. Res., B, Paper 4B0163

6575 Surface of planets (impact metamorphism)
CHEMICAL AND STRUCTURAL CHANGES INDUCED BY THERMAL ANNEALING OF SHOCKED FELDSPAR INCLUSIONS IN IMPACT MELT ROCKS FROM LAPPAJÄRVI CRATER, FINLAND
A. Bischoff (Institut für Mineralogie, Corrensstraße 24, D-4400 Münster, W-Germany) and D. Stöffler

Plagioclase and microcline of clastic mineral and rock inclusions in impact melt rocks (kärnäite) were sampled from the coherent melt sheet located in the central crater area of the Lappajärvi meteorite crater and analyzed by optical, electron optical, x-ray, and microprobe methods. Both types of feldspars display strong chemical, textural, and structural alterations compared to the feldspars of their parental crystalline basement rocks as a result of the thermal energy supplied by the surrounding superheated impact melt. Increase of shock experienced by the clasts prior to their incorporation into the melt results in increasing thermal alteration by the melt. In a lower degree of shock both primary plagioclase and microcline transform to "checkerboard"-textured grains which consist of 5-10 µm sized subgrains of parallel optical orientation embedded in a mesostasis of eutectically grown sanidine and quartz. The subgrains are strongly zoned, disordered labradorite to andesine, rimmed by sanidine. In a high degree of shock the small subgrains are larger and randomly oriented. The subgrains are the result of a non-equilibrium fractional crystallization from a liquid state during which a strong chemical exchange between the melt and the feldspar inclusions took place. On the basis of model calculations it is concluded that the temperature of the kärnäite melt at the time of the incorporation of the clastic debris was in the range of 1800 to 2100°C. The equilibration temperature of the clast-melt mixture is estimated accordingly to be at least in the range of 1100 to 1140°C or higher depending on the magnitude of the clast's post shock temperature. This temperature is above the solidus and in part above the liquidus temperature of a dry granodioritic melt and also above the solidus temperatures of the feldspars. From the textural setting of the minerals and lithic clasts in the kärnäite it must be concluded that the clast-laden Lappajärvi melt was at rest at the time the equilibrium temperature was reached. (Shocked feldspar, impact melt, Lappajärvi crater, impact metamorphism).
J. Geophys. Res., B, Paper 4B5124

6515 Surface of Planets
A PROFOUND BECAUSE FOR PALIMPSESTS AND ANOMALOUS PIT CRATERS ON GANYMEDE AND CALLISTO
S.B. Croft (Lunar & Planetary Laboratory, University of Arizona, Tucson Arizona 85721)

Palimpsests and anomalous pit craters are two ...

Planetology

Seismology

Social Sciences

Solar Physics, Astrophysics, and Astronomy

Tectonophysics

Volcanology